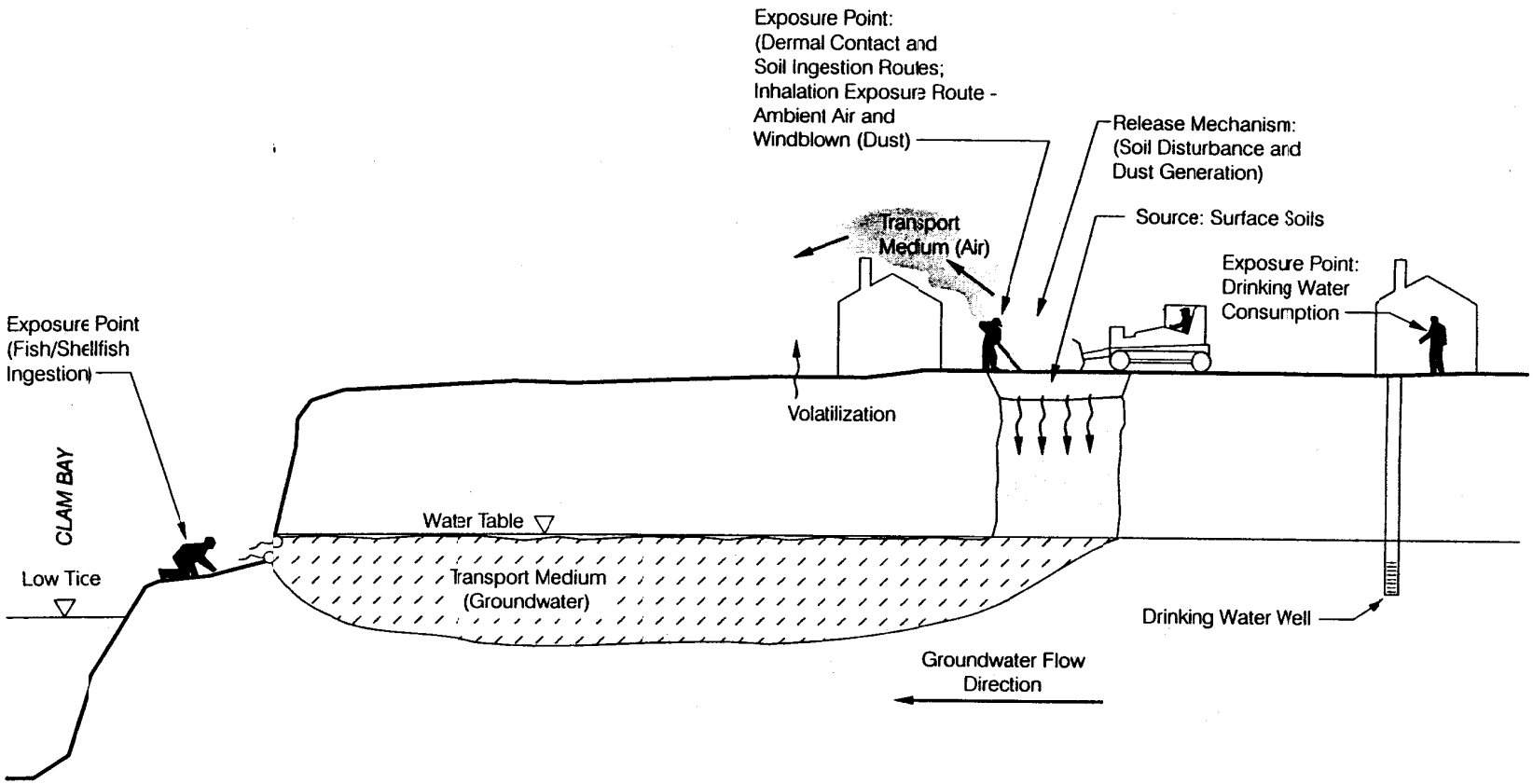
Baseline Exposure Pathways



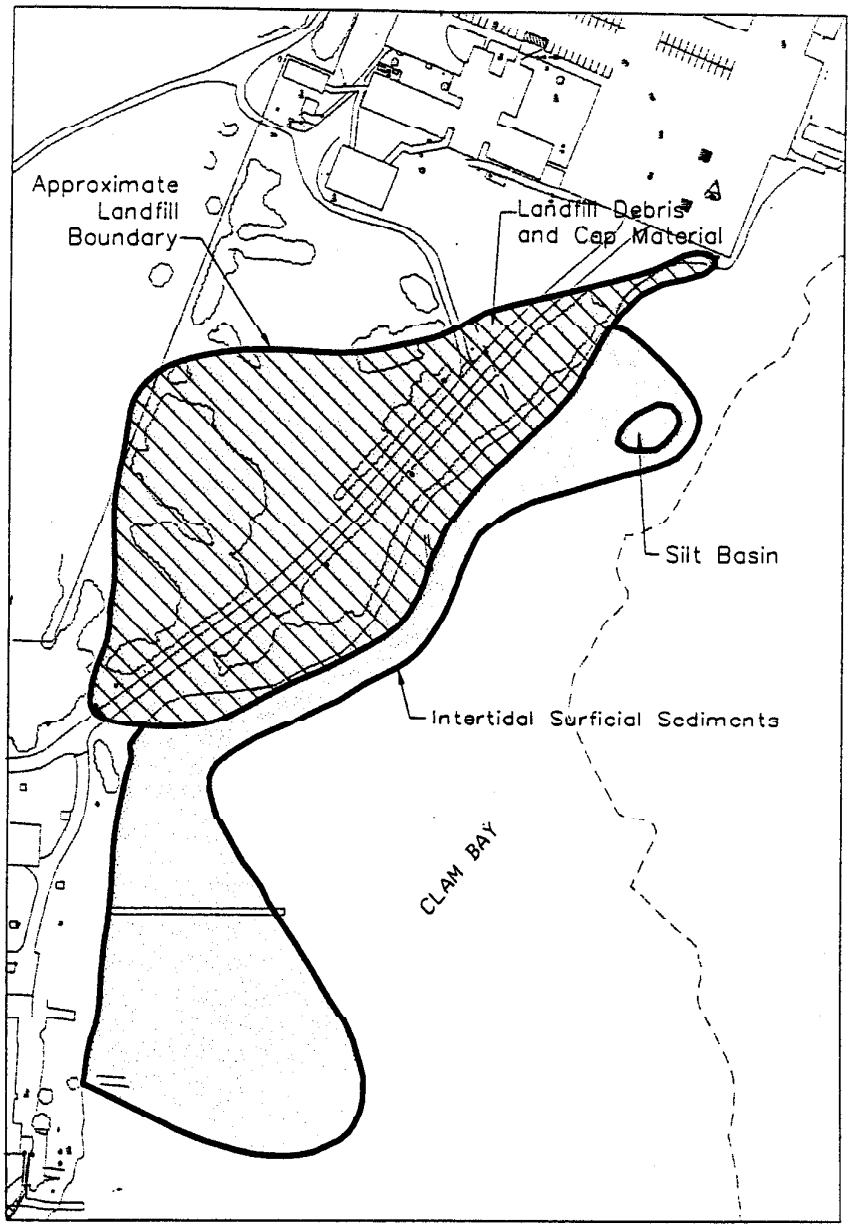
NO TO SCALE

HARTCROWSER J-4191-19 9/97

Figure 6

cord\419119\expos

Areas Exceeding Soil and Sediment Cleanup Levels in Landfill and Clam Bay



N

0 250 500

Scale in Feet

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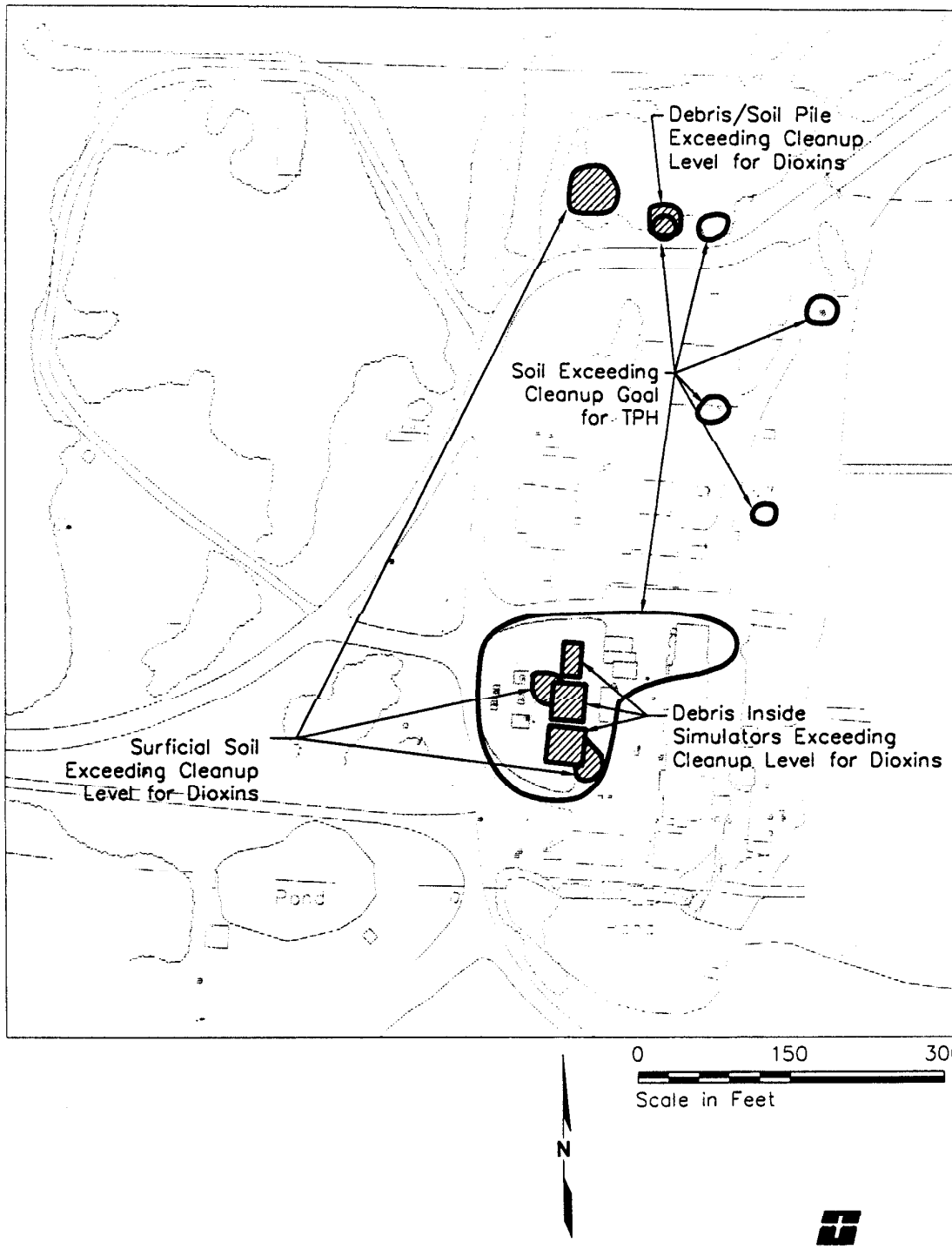
Figure 7

CWD 6/30/97 1-25C woodlk.pcp
41911901

Areas Exceeding Soil Cleanup Levels and Goals in Fire Training Area



CVD 9/9/97 1=150 woodstk.pcp
41911909

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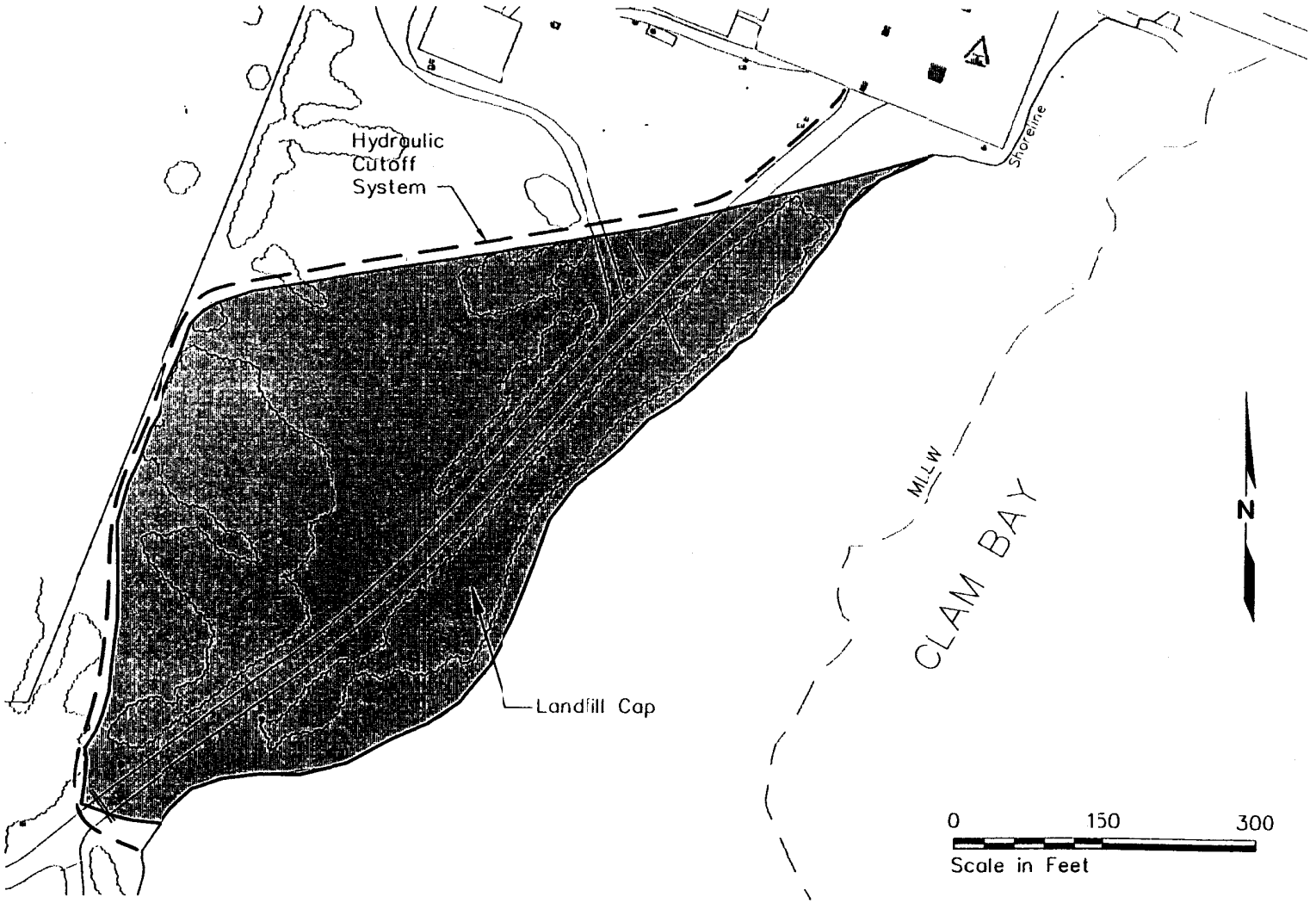
J-4191-19 9/97

Figure 8

Alternatives 2A and 3A
Approximate Areal Extent of Landfill Cap and Hydraulic Cutoff System



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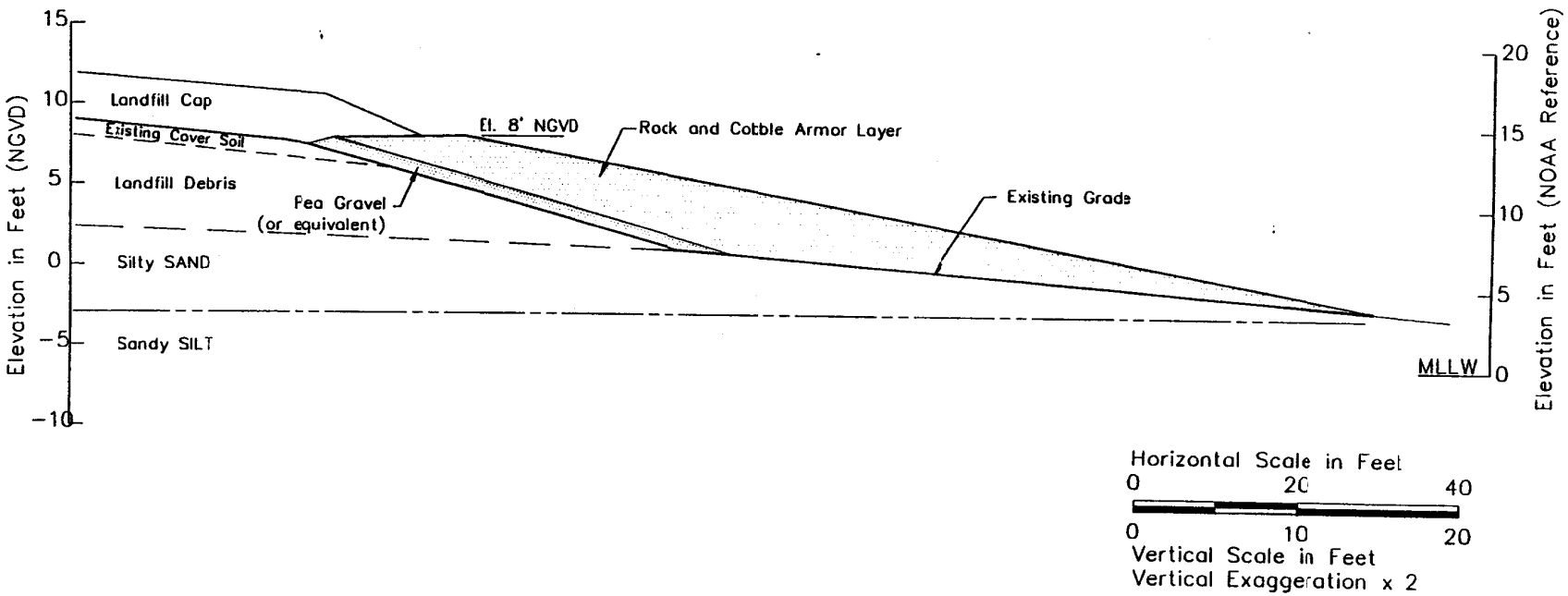
J-4191-19 9/97
Figure 9

CVD 6/30/97 1=10 wdetk.scp
41911907

Alternative 2A - Armoring over Intertidal Debris

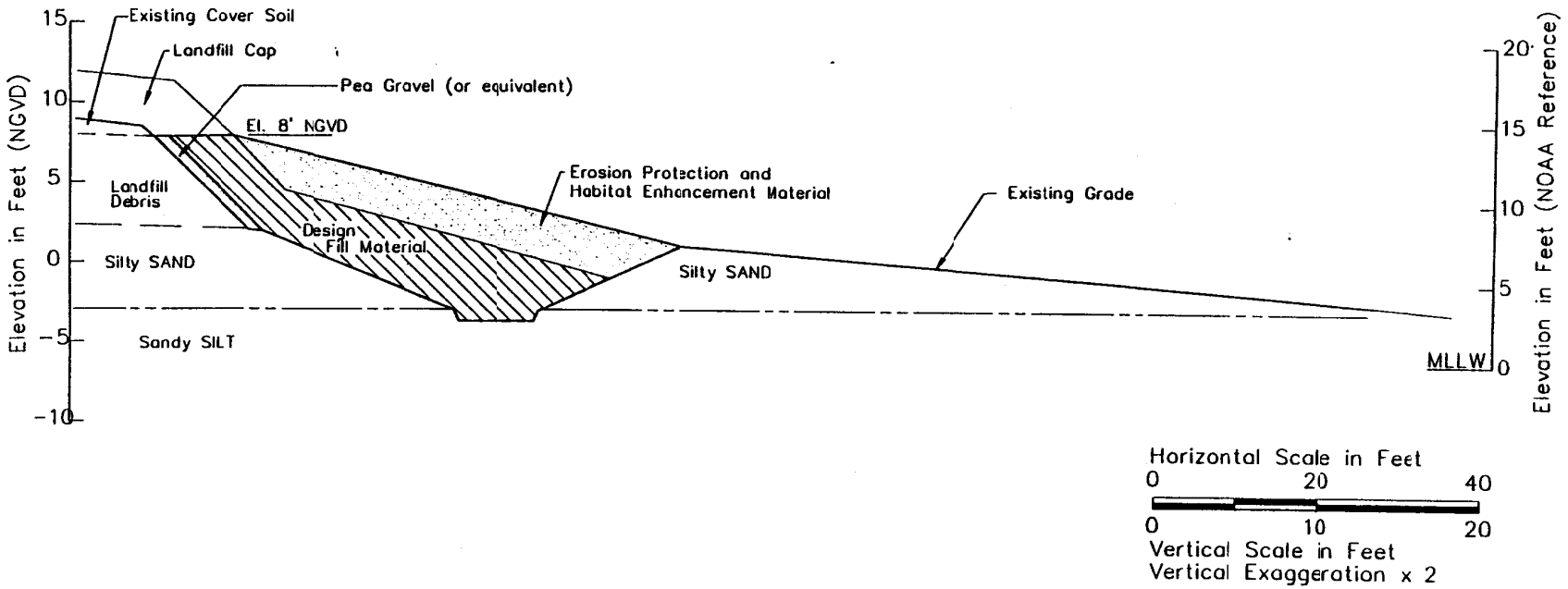
Typical Section



HARTCROWSER
J-4191-19 9/97
Figure 10

Alternative 3A - Excavation of Intertidal Debris and Placement of Design Fill

Typical Section



HARTCROWSER
J-4191-19 9/97
Figure 11

ATTACHMENT A
RESPONSIVENESS SUMMARY

ATTACHMENT A
RESPONSIVENESS SUMMARY

INTRODUCTION

This **Responsiveness Summary** addresses comments on the Proposed Plan for Site Cleanup, Manchester Annex Superfund Site, Manchester, Washington, dated March 1997. The public comment period for the Proposed Plan was from April 2 to May 2, 1997, and a Public Meeting was held on April 16, 1997, at the Manchester Public Library in Manchester, Washington. In addition, two briefings were held at the Manchester Environmental Laboratory on March 31, 1997, for employees of EPA, the Washington State Department of Ecology, and the National Marine Fisheries Service, who work at the site. Questions and comments received during both the employee briefings and the public comment period are addressed in this responsiveness summary.

SUMMARY OF COMMENTS

In total, 54 comments were submitted to the Corps concerning the Proposed Plan. Comments were received from the following sources:

- Three verbal comments were received during the Public Meeting;
- One written comment was submitted on the comment form which accompanied the Proposed Plan;
- Twenty-one verbal comments were received during the two employee briefings held at the Manchester Environmental Laboratory;
- Two verbal comments were received by phone from Washington State offices; and
- Twenty-seven written comments were submitted by three branches of EPA:
  - Nine comments from the Director of EPA's Facilities Management and Services Division (FMSD);
  - Eleven comments from the Director of the EPA Manchester Laboratory; and
  - Seven comments from the Director of EPA's Office of Management Programs (OMP).

Copies of the transcripts for the Public Meeting are available at the public repositories listed in the Community Participation section of the Record of Decision, and a copy is part of the Administrative Record. Copies of the letters received and conversation records have been included in the Administrative Record.

RESPONSE TO COMMENTS

The comments and accompanying responses are arranged under the following eight topics:

1. Remedial Action Preferences
2. Health and Safety Concerns
3. Environmental Concerns
4. Remedial Design Issues
5. Remedial Action Implementation Issues
6. Post-Remedial Operation, Maintenance, and Monitoring Issues
7. Coordination with Other Agencies/Programs
8. Other Issues

Those comments which apply to more than one topic appear under the heading considered the most appropriate. Public comments are addressed first within each topic. Paraphrasing was used to incorporate related concerns expressed in more than one comment. Every attempt has been made to accurately represent and to respond to all comments received.

1. Remedial Action Preferences

Comment 1a. [Public Meeting] I'm Richard Brooks with the Suquamish Tribe. We support the preferred alternative, Alternative 3A.

Response: *Comment noted.*

Comment 1b. [Mail-in] I prefer the Alternative 3A for the Landfill & Clam Bay sediments and Alternative 2B for the Fire Training Area.

Response: *Comment noted.*

Comment 1c. [C. Hossum, Agency for Toxic Substances and Disease Registry] I just got a copy of the proposed plan for cleanup at Manchester dated March '97, and it looks great. It looks like a wonderful idea to get the information out, too. As far as the plan goes, I have no problem with it. I think the preferred alternatives are fine from our stand point.

Response: *Comment noted.*

Comment 1d. [EPA OMP] I concur with the recommendation of cleanup alternative 3A for the landfill and Clam Bay sediments and cleanup alternative 2B for the Fire Training Area. It must be emphasized, however, that regardless of the remediation undertaken, the final ratification will be the monitoring results for the site. If the proposed alternative does not result in the site being judged acceptable within existing environmental parameters, further remediation will have to be undertaken by the Department of Defense or the U.S. Army Corps of Engineers.

Response: *Comment noted.*

2. Health and Safety Concerns

Comment 2a. [Employee Briefing] A lot of us are concerned about the health and safety of the employees working at the laboratory as well as the potential contamination problems we may have inside the laboratory during the excavation and movement of the shoreline debris. Do you plan to prepare a site safety and health plan that will address these concerns?

Response: *A Site Safety and Health Plan (SSHP) will be prepared by the construction contractor. The design will require the contractor to consider these factors in his SSHP submittal.*

Comment 2b. [Employee Briefing] What do you plan to do to reduce or eliminate the off-gassing of the vinyl chloride and other volatile materials during the excavation and spreading of the sediments and soils on the landfill?

Response: *Vinyl chloride was only detected at very low concentrations (maximum concentration of 0.28 parts per million) in a couple of areas of the upland landfill. Volatile materials are not expected to be a problem at the toe of the landfill because of the high energy environment. And only low concentrations would be expected in the upland landfill, because of the age*

of the landfill. The SSHP prepared by the construction contractor will address air monitoring during construction activities.

Comment 2c. [Employee Briefing] Is there any danger if someone walks around the landfill now?

Response: *No. Risks are minor unless someone digs down below the existing soil cap that the Navy placed over the landfill. As a precaution, the EPA Lab has posted the landfill area with "Keep Out" signs.*

Comment 2d. [Employee Briefing] How close is the contaminated area to the laboratory buildings?

Response: *The nearest portion of the landfill is about 150 to 200 feet from the office building.*

Comment 2e. [Employee Briefing] I have a concern about enforcement of the restriction on subsistence shellfish harvesting. I think that in reality it will be difficult to tell whether someone is a recreational or a subsistence harvester.

Response: *Results of the baseline risk assessment performed for the site indicate that potential health risks associated with subsistence-level consumption of shellfish collected from the intertidal area of Clam Bay are above levels targeted by the state cleanup program. The amount of shellfish consumed by the subsistence-level harvester was assumed in the risk assessment to be approximately 23 kg (or about 150 meals) per year. There is currently a restriction on both recreational and subsistence-level shellfish harvesting in Clam Bay. However, if the restriction were not in place, it is unlikely that current conditions in the intertidal area could support this high level of shellfish harvesting. The Suquamish Tribe has preliminary plans to conduct shellfish enhancement activities at the site after completion of construction activities. A restriction on subsistence-level shellfish harvesting will remain in-place after remedial construction, until the Washington State Department of Health and the Suquamish Tribe determine that the shellfish are safe for subsistence-level harvesting. The Suquamish Tribe will be responsible for enforcing this restriction.*

Comment 2f. [EPA Manchester Lab] Our primary concern is for the health and safety of the employees and contractors who work at the laboratory facility and how they will be protected during the cleanup activities. Besides a strong moral commitment, we are required by law to provide a safe and healthful workplace for these employees. A critical part of the cleanup will be the design and implementation of the site safety and health plan for this project. We request

that the U.S. Army Corps of Engineers and their contractors work closely with us in designing this plan so that the work can be accomplished without exposing the laboratory workers to asbestos fibers, harmful dusts and vapors, noise or other hazards. The close proximity of the landfill to our facility creates special exposure problems and we want to advise, review and concur on the site safety and health plan before the cleanup project begins.

Response: *The health and safety of contractors and site employees is of utmost concern to the Corps and the Superfund program. The EPA Lab will be given opportunity to provide input, review, and comment on the Site Safety and Health Plan before construction activities begin.*

Comment 2g. [EPA Manchester Lab] The site safety and health plan should include a comprehensive air and noise monitoring scheme that includes real-time as well as standard industrial hygiene monitoring of these hazards. The shoreline area contains substantial quantities of asbestos debris as well as metals, PCBs, and other contaminants. We are concerned about the potential generation of asbestos fibers and harmful dusts during the cleanup work. The fresh air intake that supplies air to the laboratory is located on the south side of the laboratory mechanical room and the ventilation pumps and air intakes for the Office Building are located on top of this structure. Both of these fresh air intakes are located close to the old landfill. What type of dust controls will be used to control the generation of particulate during the construction activities? Will provisions be made to monitor for particulate at these locations and contingencies implemented to stop work if airborne levels exceed agreed to action levels?

Response: *Specific dust control measures will be presented in a Remedial Action Management Plan (RAMP), which will be developed by the Corps and approved by EPA prior to site work. The EPA Lab will be given opportunity to review, comment, and provide input to the RAMP. Examples of dust control measures which may be used include the following:*

1) Spraying with water or oil/water emulsion to control dust.

2) Speed limits for trucks on site to minimize dust generation.

3) Sequencing or phasing of work to minimize generation of dust.

A real-time air monitoring program will be instituted to monitor dust levels. Contingencies will be in place to stop or modify work if dust exceeds agreed upon action levels. The dust action levels and required construction actions will be described in detail in the RAMP. Asbestos and other landfill contaminants will be addressed in the construction monitoring plan.

Comment 2h. [EPA OMP] We want to ensure that neither the health of our employees nor the quality of our lab analyses is compromised. The fresh air

intakes for our lab are situated on top of the building in such close proximity to the remediation site that it would be advisable for US Corps to undertake monitoring at the fresh air intake and inside the lab.

Response: *See response to Comment 2g. The merits of monitoring at the fresh air intakes and/or inside the lab will be considered during development of the RAMP. Monitoring immediately downwind of construction activities will be a key component of the monitoring program, since particulate concentrations will be highest close to the source.*

3. Environmental Concerns

Comment 3a. [Public Meeting] I'm Ann Boeholt with the Department of Fish & Wildlife. My comment is that the comment was made that mitigation is not going to be required with the preferred alternative for the toe of the landfill. I would like to say that, from our standpoint that has not been ascertained as of yet; it sounds like, for one, that there may still be some armoring required of the bank. And certainly, even though there would be excavation rather than simply capping what's there, the excavation will cause disturbance of the existing toe and so there may be mitigation. Not to the extent that there would be with Alternative 2A.

Response: *Comment noted. The objective of this alternative is to minimize the impact to the aquatic habitat and maximize long-term beach stability. This alternative was selected, following extensive input and discussion by the Manchester Work Group, to avoid the need for mitigation measures included in other alternatives considered. We will continue to coordinate with the Work Group (of which WDFW is a member) throughout design and construction to achieve the remedial action goals, including no net loss of habitat function.*

Comment 3b. [Employee Briefing] Can you discuss some mitigation ideas for the landfill wetlands? Would it be possible to do the mitigation in Beaver Creek above the Navy pond?

Response: *A determination regarding whether mitigation is required has not yet been made. If mitigation is required, the most likely area is currently thought to be enhancement of the wetlands on the south side of the landfill or in the Beaver Creek drainage above the Navy ponds.*

Comment 3c. [Employee Briefing] Do you know if the stream on the west side of the landfill is picking up any leached material now?

Response: *Most of the stream flow is rainfall runoff. The remedial action includes installation of a curtain drain (hydraulic cutoff system) around the perimeter of the landfill, including the west side. The curtain drain will be designed to intercept shallow groundwater and rainfall runoff prior coming in contact with the landfill.*

4. Remedial Design Issues

Comment 4a. [Employee Briefing] Will the access road to the laboratory be raised along with the landfill?

Response: *This is a design question that will be decided during the remedial design phase. It will either be left as it is and the landfill graded in or the road will be raised.*

Comment 4b. [Employee Briefing] Do you know if PCB fluid is in the UST tanks? Will all fluids be pumped out of the USTs?

Response: *When the concrete USTs were sampled and tested, sludge and PCBs were found in them. The sludge and PCBs will be removed prior to in-place closure of the USTs. Associated piping also will be removed if possible. If existing utility lines make it impractical to remove some piping, those pipes will be purged in-place and abandoned.*

Comment 4c. [EPA FMSD] The master plan for the Manchester Lab calls for the expansion of existing laboratories which would require the construction of additional parking over the area of the landfill. Any remediation solution should not unnecessarily impinge upon the ability of the Manchester Lab to carry out its master plan. In this case, all proposed landfills should be designed and placed to a degree sufficient to support the proposed future parking areas.

Response: *The landfill cap will be designed in such a way that it will be compatible with construction of a future parking lot on the northern portion of the landfill.*

Comment 4d. [EPA Manchester Lab] A Facility Master Plan for the projected use and expansion of the laboratory facility was completed in 1994. A copy of this plan was sent to the US Corps as a part of our original comments during the RI/FS comment period. The Master Plan contemplates a parking area immediately south of the laboratory for employee parking allowing building expansion to the north into the existing parking lot. We request that the landfill cap and new roadway be designed so that EPA can utilize this area as projected in the Master Plan. The proposed fill area should be designed so that the

northern portion of the site is level and as near current grade as possible to allow for future utilization as the laboratory's parking area.

Response: *See response to Comment 4c.*

Comment 4e. [EPA OMP] Upon completion of the remediation, it appears that the main entrance road to the lab will need to be rebuilt above the proposed cap. Since the lab's Master Plan calls for significant construction in the future, the reconstructed road should be built to meet the same design criteria as our existing road, which is capable of supporting heavy equipment and tank trucks. If the roadway is to be re-routed, consideration must be given to the impact on the main lab entrance as described in the Master Plan.

Response: *If the existing access road is demolished, an access road with the same design criteria as the existing road will be included in the design specifications.*

Comment 4f. [EPA FMSD] Although the proposed plan indicates the cap will be designed to control infiltration of rainwater, the preferred alternative 3A does not specify that the cap will include revegetation. Please provide clarification on whether appropriate grading and revegetation will be included in the preferred alternative 3A for the landfill. In addition, consideration should be given to designing the fill contours to include berms to screen future parking, and allow the Entrance Road alignment and grades to enhance views of Clam Bay and to promote safe traffic flow of employees and guests as well as service vehicles.

Response: *Aesthetic concerns will be considered in the remedial design and will be coordinated with landowners. Appropriate grading and revegetation will be included as part of the landfill cap design. The Corps will solicit input from EPA (as property owner) through the Manchester Work Group.*

Comment 4g. [EPA Manchester Lab] The design and construction of the landfill cap will affect the character of the laboratory and the site very possibly in perpetuity. The cap should include berms to screen some areas of the site. Road alignment and grades should promote safe traffic flow for employees, guests, and service vehicles and enhance views of the bay. We request that the landfill cap be designed with the assistance of a landscape architect to ensure that it is done in a functional and aesthetically pleasing way.

Response: *See response to Comment 4f.*

Comment 4h. [EPA Manchester Lab] A large (30-inch?) storm water drain line runs from just north of the Laboratory Annex Building to the southeast and into

Clam Bay. This concrete pipe likely allows some backflow of seawater into the landfill. The possible leakage of the pipe could add water to the landfill or conversely, the pipe might act as a drain for it. This storm line drain (and any others) should be eliminated or rerouted.

Response: *The need to plug and/or reroute existing storm drains in the vicinity of planned construction activities will be evaluated during the design phase. The Corps will coordinate with EPA Lab if the design team determines that modifications are necessary which could impact facility operations.*

Comment 4i. [EPA Manchester Laboratory] We have technical questions and comments that we anticipate being addressed during the design phase of this project. Some of these questions and comments are as follows:

a. The material on the beach, primarily consolidated metal debris, may be extremely difficult to break up, remove from the beach, and place on the upland portion of the fill. The material may be difficult to properly compact leaving voids present throughout the landfill. This could cause differential settlement and cracking of the cap. The structural stability of the fill could be particularly important if the access road is to be placed across it in its existing alignment. How do you plan to break up the debris material to spread it over the landfill portion of the site prior to capping?

b. There are no details on the design fill except that it is anticipated that the fill will mitigate the concentration of metals in the seeps. The FS indicates at 4-12 that the fill should result in order of magnitude reduction in the concentration of seeps, thus meeting Remedial Action Objectives. There is no indication of what will happen if this does not occur or whether some subsequent remedial action would be required. The intertidal fill will apparently lower the tidal influence on the landfill. However, because it is "semi-permeable" the intertidal design fill will allow some infiltration into the landfill material at high tide or repeated high water, further contributing to seeps.

c. There are no details on the nature of the dike to be constructed to protect the excavation from the tidal movement.

d. There is no information on the relative importance of groundwater versus precipitation versus saltwater infiltration on creation of seeps from the landfill. We could not find technical information in the RI/FS about the groundwater flow in the landfill. It is assumed that the groundwater cutoff will result in a significant reduction of flow into the landfill and a resulting significant reduction of seeps.

e. From the Feasibility Study, the cross section of the trench indicates that the trench is lined with a fabric but not an impermeable membrane. Therefore, this would appear to do little to cut off the groundwater except to provide an alternate, more permeable pathway for groundwater to leave the area. Since the trench is keyed into the sandy silt, it would appear that the trench is deep

enough (elevations are not provided) to allow the free movement of saltwater back into the trench system at high tides. This would expose the landfill to an additional source of water which presently does not exist. Also, groundwater would not flow out of the trench at high tides. We would like to review elevations, slopes of the trench, and the construction details during the design. One suggestion is that the gravel cutoff trench be replaced with a slurry wall or some other form of an impermeable barrier to groundwater flow. The groundwater would be diverted around the fill as with the trench but in a more positive manner. A wall that would be keyed into the sandy silt layer and the design fill on the intertidal area would not provide a conduit for saltwater backing up into the fill.

A slurry wall would be more expensive than the gravel trench and require more difficult and involved construction. An alternative would be the use of an impermeable membrane on the downstream, landfill side of the gravel trench. This would eliminate any groundwater flow into the landfill but would not eliminate potential flow of saltwater back into the trench system. Depending on the hydrogeology at the site, a drainage system may be necessary outside of the low permeable barrier surrounding the landfill.

f. The specific design for the landfill cap has not been determined. The FS at 4.4 talks about the lack of a need for a RCRA cap on the landfill because lead levels in the seeps are below Remedial Action Objectives. However, several other metals and PCBs which are also of concern. The concerns for any cap are the requirements to protect against direct contact with the fill, the reduction of precipitation and infiltration, and stability and reliability over time. One of the decisions to be made during the design is what type of a cap can meet these objectives.

Response: *Comments noted. These concerns and questions will be addressed during the design phase. The EPA Lab will have an opportunity to review design and construction documents produced during the cleanup project.*

5. Remedial Action Implementation Issues

Comment 5a. [Employee Briefing] I am concerned about the cleanup and tracking of mud from the contaminated area onto private vehicles, delivery trucks, and other vehicles entering and leaving the laboratory and the site during the construction activities. What will be done to eliminate the spreading of the contaminated soils and sediments out of the contaminated work area?

Response: *A decontamination area will be set up to prevent movement of soils and mud outside the remediation area. Area access and movement of vehicles will also be controlled with temporary fencing.*

Comment 5b. [Employee Briefing] There may be a lot of vibrations that affect some of the sensitive laboratory instruments during the cleanup construction activities.

Response: *This will be addressed in the design phase, with the lab's input.*

Comment 5c. [Employee Briefing] The Old Navy Dump/Manchester Superfund Site Schedule handout indicates that you plan to start the cleanup work in the summer/fall of 1998. How long will it take to move the shoreline debris and spread this material over the landfill area?

Response: *Many details have to be considered before a reliable estimate can be made. It depends on the design and the contractor's capability. The diking and excavation of the landfill debris alone may take 6 months.*

Comment 5d. [Employee Briefing] What kind of mechanical processes and equipment will be used to excavate the shoreline debris?

Response: *We plan to construct a dike to stop the tidal flow to be able to work at the toe of the landfill. We anticipate the contractor will use a large piece of equipment to pull out chunks of debris, and that a hydraulic sheer will be used to cut the material. The material will be consolidated on the upland portion of the landfill.*

Comment 5e. [Employee Briefing] We are concerned about possible damage to the NMFS seawater lines that cross Clam Bay when the thin cap material is spread over this area. Can the thin cap material be installed without damage to our existing seawater lines?

Response: *The design contractor will coordinate closely with NMFS to locate the lines and ensure adequate line protection during construction. This may include doing the work at high tide.*

Comment 5f. [EPA FMSD] Of primary concern during the actual remediation, is maintaining continuous and uninterrupted access to the lab. Adequate arrangement should be made for alternate access during the excavation in the shore area, landfill operations, and cap installation. Access through the State Park may provide an acceptable short-term alternative. The remedial design should also include reconstruction of the road system leading to the lab, from the Beach Drive entrance, through the landfill/work area, to the lab complex. Even if actual excavation and landfill take place in areas outside the road

corridor, we expect that heavy construction equipment will severely damage the existing road.

Response: *Continuous access to the Manchester Lab will be incorporated into the remedial design. Negotiations with the Washington State Department of Parks & Recreation are currently underway for a temporary access road, in the event that one is needed. If the existing road is damaged or demolished, it will be repaired or replaced in kind.*

Comment 5g. [EPA Manchester Laboratory] It is very likely that the access road will be heavily affected during construction activities and will be unavailable for long periods of time. Since the laboratory will remain open during construction activities, what provisions will be made for continuous access to the facility?

Response: *Continuous access will be provided. If the existing road needs to be closed or demolished as part of the cleanup project, a temporary access road will be constructed.*

Comment 5h. [EPA OMP] During the remediation process, continuous access must be maintained for the Manchester Lab. This may represent up to 200 vehicles per day. What alternatives will be considered if Washington State Park denies permission for creation of a temporary access road through their property?

Response: *Continuous access to the Manchester Lab will be incorporated into the remedial design. Negotiations with Washington State Department of Parks & Recreation are currently underway for a temporary access road. In any event, it is recognized that access options will be evaluated during the design phase.*

Comment 5i. [EPA Manchester Laboratory] The laboratory will continue full operation during cleanup activities. Because of this we are concerned about the potential contamination problems that may arise in our chemistry area, particularly in the inorganic operation, when chemists are analyzing environmental samples during the cleanup. Our laboratory is capable of very low level analysis in the parts per trillion range. What steps will be taken to insure that laboratory processes are not compromised during remedy construction? Can a provision be made for stopping work if dust is generated that cannot be controlled using wetting or misting methods?

Response: *(See also response to Comment 2g.) The Corps will do everything possible to minimize dust generation and migration. Performance standards will be developed for control of dust. The performance standards will be*

developed with EPA Lab input and documented in the RAMP. Corrective actions will be required, including stopping work if necessary, if these performance standards are exceeded.

Comment 5j. [EPA FMSD] It is not clear to FMSD that US Corps is fully aware of the existing system of utility lines that cross the Manchester Annex Superfund Site and considered them in the preferred alternative selection. As shown by Attachment A, an old storm drain line travels through the proposed landfill area. Also the water and sewer lines for the Manchester Laboratory are located to the east of and parallel to the existing EPA security fence. The location of utility lines should be considered during the design, construction, and post-construction phases of any remediation, with particular attention to maintenance of uninterrupted utility service during the remediation construction period.

Response: *The Corps is aware of the utilities mentioned, and will work closely with the EPA Manchester Laboratory and National Marine Fisheries Service (NMFS) to minimize impacts to existing utility lines at the site. Utility lines will be located and addressed in areas where remediation work will take place during the design and construction phases of the project. If interruptions or outages are unavoidable, the Corps will coordinate with the EPA Lab and NMFS to minimize the impact to EPA's and NMFS's daily operations.*

Comment 5k. [EPA Manchester Laboratory] The pressurized water and sewer lines for the laboratory are located to the east of and parallel to the existing EPA security fence. Will these lines have to be moved as a part of the landfill capping work? If the lines must be moved, what provisions will be made to insure these services are available to the lab during construction activities?

Response: *A relatively small quantity of landfilled solid wastes are located west of the utility corridor, on Manchester State Park property. Construction of a cap over the utility corridor should be avoided. The likely solution (to be determined during remedial design) will be to consolidate the wastes to the east side of the corridor prior to capping them. An alternative solution would be to relocate the utility corridor to outside the waste area. The Corps will coordinate with EPA Lab if the design team determines that it is necessary to move the lines. The Corps' goal will be to avoid any service interruptions to the labs on site.*

Comment 5l. [EPA OMP] Will the existing water and sewer lines at the site risk compromise due to the remediation? If so, what provisions have been considered to ensure uninterrupted service to the lab?

Response: *See responses to Comments 5j and 5k.*

6. Post-Remedial Operation, Maintenance, and Monitoring Issues

Comment 6a. [EPA FMSD] Although FMSD is, via a previous administrative transfer, the owner of the Superfund site, FMSD recognizes that the U.S. Navy is solely responsible for the contamination at the site that is currently undergoing remediation pursuant to 40 CFR 300 under the Department of Defense (DOD) Formerly Utilized Defense Sites (FUDS) Program. In light of this, OA expects that the DOD FUDS Program and/or US Corps will also be responsible for post-remediation activities associated with maintaining the integrity of the preferred alternative, such as required operation and maintenance, long-term environmental monitoring, future information reporting and review requirements, maintenance of institutional controls, and any other unforeseen remediation or environmental monitoring.

Response: *The Corps will be responsible for operation and maintenance, monitoring, and reporting in accordance with an approved O&M Plan and the FUDS program requirements. The EPA Lab and other members of the Manchester Work Group will have input on the O&M Plan. Specific O&M requirements, including length and extent, will be determined after the details of the remedy are determined and designed.*

Comment 6b. [EPA OMP] Once the remediation at the site is completed, I believe that there will be a continuing need for operation and maintenance, monitoring and recordkeeping, reporting, and possibly further remediation. This could result in a significant resource consideration. I would like to see these responsibilities clearly delineated for DOD or US Corps, whichever is appropriate.

Response: *The DOD is responsible for the cleanup costs under the Formerly Used Defense Sites (FUDS) program. See response to Comment 6a.*

Comment 6c. [EPA Manchester Laboratory] We believe the US Corps as the Department of Defense (DOD) cleanup representative is responsible for any long-term operations and maintenance (O&M), monitoring, and recordkeeping that will be needed for this site forever or as long as the contaminated materials remain on our property. If the proposed alternative selected includes leaving the contaminated soils and sediments in the landfill, we request that the DOD assume full responsibility for the long-term maintenance of the site as an adjunct to their responsibilities for the cleanup.

Response: *See response to Comments 6a.*

7. Coordination with Other Agencies/Programs

Comment 7a. [J. Schmidt, Manchester State Park] His concern was the impact the removal and disposal of material will have on the operation of the park. He informed us that we would need clearances prior to any work being done. He also requested that the following person be added to the mailing list for future information:

Mr. Chris Regan
WA Dept. of Parks & Recreation
7150 Clean Water Lane
PO Box 42650
Olympia, WA 98504-2650

Response: *Appropriate clearances and/or leases will be obtained through coordination with Washington Dept. of Parks & Recreation. Mr. Chris Regan will be added to the mailing list.*

Comment 7b. [EPA FMSD] The remediation of the Manchester Laboratory site represents a situation where the goals and objectives of the various components of EPA may not be identical. For example, the goals and objective of EPA's Superfund Program may differ from the goals and objectives of the Facilities Management and Services Division (FMSD), as the title holder and owner of EPA's real property assets; EPA Region 10's Office of Management Program (OMP), as steward of the Manchester Laboratory; and EPA Region 10's Office of Environmental Assessment (OEA), as the occupant and operator of EPA's Manchester Laboratory. Therefore, future documents should specifically and clearly identify the particular roles of each EPA program or office making a decision, accepting a responsibility, or being made subject to restrictions in the course of the remediation process. For example, the proposed plan does not specify which EPA office is working with the U.S. Army Corps of Engineers to design and manage remedial activities, who is responsible for CERCLA enforcement, etc.

Response: *In general when EPA is mentioned in memoranda, letters, and documents, they refer to EPA in the Superfund Program role. Otherwise, the specific offices will be distinguished if in such context or reference. In general, when the documents refer to EPA as a property owner, the term "EPA Lab" will be used. The Corps has requested that the offices representing EPA as property owner designate one point-of-contact (POC) to streamline the communication between EPA, FMSD, OMP, OEA, and the*

Corps. Having a primary EPA POC will allow the exchange of information to occur as efficiently as possible during design and construction.

Comment 7c. [EPA FMSD] As administrative controls or land use restrictions contemplated in connection with the proposed remediation will impose restrictions on FMSD, OEA, and OMP's use of the site and future expansion of the Manchester Laboratory, FMSD, OEA, and OMP should be involved in establishing any administrative controls or land use restrictions affecting EPA's site and participate in the development of any long-term administrative controls imposed on the landfill, curtain wall, and cap areas. Any proposed land use restrictions should be clearly and officially communicated to FMSD, OEA, and OMP.

Response: *The Corps will coordinate with property "owners," including EPA, regarding any long-term proposed land use restrictions at the site.*

Comment 7d. [EPA FMSD] Obviously, design of the final remediation will involve many decisions that affect the short-term and long-term functioning of the Manchester Lab. FMSD, OEA, and OMP should be heavily involved as the design of the Remedial Plan moves forward.

Response: *EPA (as property owner) will receive draft copies of design documents for review, and their input will be solicited through the Manchester Work Group. In addition, the Work Group will be provided periodic briefings on the design.*

8. Other Issues

Comment 8a. [EPA FMSD] FMSD and OMP are currently working with the State of Washington to obtain a renewal of the tidelands/bedlands lease connected with the laboratory's pier. Any remediation plan should not contain any provisions which would prevent FMSD and OMP from obtaining a renewal lease, and should address any concerns the State of Washington has regarding contamination of the tidelands/bedlands in this area of Clam Bay.

Response: *Cleanup of the Clam Bay tidelands/bedlands has been coordinated with the State of Washington Department of Natural Resources (DNR), which is represented on the Manchester Work Group. Since the cleanup project will stop the source of contamination to the tidelands and remediate a portion of the tidelands, it should not have any adverse impacts on lease renewal, and may be beneficial in obtaining a renewed lease.*

Comment 8b. [EPA OMP] My office is working with the Washington State Department of Natural Resources to renew a lease for the tidelands and bedlands beneath the laboratory's pier. Any remediation undertaken should address any concerns DNR may have with regard to future contamination of the tidelands/bedlands so that it does not preclude the issuance of a lease for the tidelands/bedlands.

Response: *See response to Comment 8a.*

Comment 8c. [EPA Manchester Laboratory] When this site was listed on the National Priorities List, the laboratory's internal hazardous waste generator identification number was used in the preparation of the listing. The laboratory generates hazardous waste as a part of our internal laboratory activities and this waste stream and associated records must be maintained separately from the Old Navy Dump-Manchester Annex Superfund site-generated waste. Hazardous waste that was generated by the US Corps during the site investigation activities and waste that will be shipped off site for disposal as a part of the Old Navy Dump-Manchester Annex Site cleanup process must have a separate hazardous waste generator identification number in order to maintain separate records and appropriate responsibilities for this waste.

Response: *The Corps has obtained and is using a separate hazardous waste generator identification number for waste generated during investigative and cleanup activities. Storage and disposition of wastes generated during cleanup activities, and any reporting requirements, will be the responsibility of the Corps.*

The Corps feels the selected remedy provides a cost-effective program for reducing site risk. In general, the public who have commented on the proposed cleanup plan have been supportive.

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TAB 16-NORFOLK

THE VIRGINIAN PILOT
(NORFOLK)

MARCH 7, 1998

EPA: Naval yard one of nation's most toxic sites

May be added to federal Superfund list.

BY CHRISTOPHER DINSMORE
STAFF WRITER

PORTSMOUTH — The U.S. Environmental Protection Agency on Friday proposed adding the Norfolk Naval Shipyard to its Superfund list, identifying the 231-year-old shipyard as one of the nation's most polluted sites.

The EPA identified six sources in the shipyard, including landfills, pits and lagoons, that release a stew of pollutants into surface water, which can then flow into the Elizabeth River or its tributaries.

Many of the contaminants were dumped in the shipyard decades ago, before the risks to the environment were known, said Mark Stephens, remedial project manager with the EPA's Region III, based in Philadelphia.

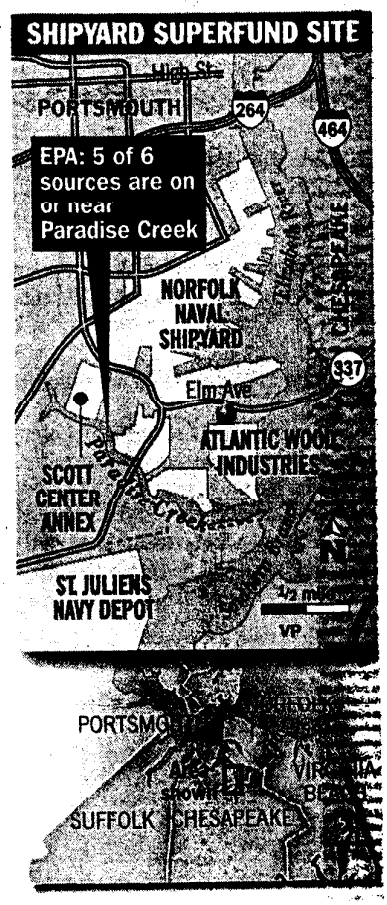
In its briefing, the EPA noted, "Before the facility began using an industrial waste treatment plant in 1979, it discharged some industrial wastes via storm drains directly into the Southern Branch of the Elizabeth River."

The river's southern branch has been identified by state and federal officials as one of three toxic hot spots in the Chesapeake Bay watershed. The river's banks have been heavily industrialized for more than a century. Another Superfund site on the river sits on a sliver of land adjacent to the Jordan Bridge, which bisects the shipyard. Creosote used there at a wood treatment plant contaminated the ground.

Stephens said Friday he is not aware of any imminent threat to human health from the toxic wastes in the shipyard.

In a statement, the Naval Shipyard said, "Although extensive

Please see **EPA**, *Page* **A13**



WHAT IT MEANS TO YOU

Although the Norfolk Naval Shipyard has been identified as one of the nation's most polluted sites, an EPA official said there is likely no threat to human health from the toxic wastes there.

EPA: Shipyard may be put on Superfund list

Continued from Page A1

sampling and analysis indicates the presence of some contamination, the levels and geophysical containment of the contaminants are such that we have no reason to believe they impact the community, human health or the environment."

Spokesman Steve Milner said the shipyard has worked closely with the EPA and the Virginia Department of Environmental Quality through the Defense Department's Installation Restoration program to identify and clean up contaminated areas.

He could not say how much the Navy has already spent cleaning up the yard. The shipyard's statement concludes that "the Navy will continue to aggressively pursue cleanup actions at the Norfolk Naval Shipyard through the (Superfund) program."

The EPA said that five of the polluted sources are along or near Paradise Creek, at the shipyard's southern end. The sixth is about 100 feet off the Elizabeth River's southern branch, the agency said.

Sediment samples taken from Paradise Creek in 1986 and 1992 detected the presence of semivolatile organic compounds, pesticides, polychlorinated biphenyls, better known as PCBs, and metals in the creek, the EPA said. The Cradock and Afton Village neighborhoods of Portsmouth abut the creek's southern bank.

The EPA's proposed Superfund listing sets in motion a 60-day comment period, after which the shipyard could be formally added to the Superfund's National Priorities List. Formal addition could take months.

Stephens, who will serve as the EPA's liaison with the Navy, said the proposed listing formalizes the agency's relationship with the Navy.

"The Navy has been working on studying the extent of the contamination," Stephens said.

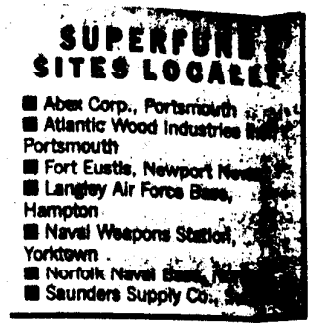
Once those studies are complete, the Navy will develop a plan in cooperation with the EPA to clean up the six sources and bring the shipyard into compliance with federal standards for clean water, air and soil, Stephens said. Timetables for the cleanup, to be paid for by the Navy, would be negotiated.

If the Navy fails, it would face possible fines and prosecutions.

The shipyard would be the third Navy facility and the fifth military base in Hampton Roads to be listed as a Superfund site.

The Norfolk Naval Base was listed last April. Other military Superfund sites in the region include the Yorktown Naval Weapons Station, Fort Eustis in Newport News and Langley Air Force Base in Hampton.

The Norfolk Naval Shipyard wraps around a wood treatment plant that is a separate Superfund site. The Atlantic Woods Industries Inc. property was added to the Superfund list in 1990 because of high levels of a dangerous compound known as polynuclear aromatic hydrocarbons, a compound in creosote.



The shipyard was one of three sites proposed Friday for the listing in the EPA's Region III, which covers the mid-Atlantic states. One of the others was the historic Washington Navy Yard in Washington, which is open to the public.

The EPA is evaluating four other sites in Hampton Roads for Superfund listing, said Kevin Wood, the EPA's National Priorities List coordinator for Region III. They are:

- The former Nansemond Ordnance Depot in Suffolk.
- The Little Creek Naval Amphibious Base.
- The St. Juliens Navy Depot, south of the naval shipyard on the Elizabeth River.
- NASA's Wallops Flight Center on the Eastern Shore.

One or more of those sites could be proposed for Superfund listing this spring, Wood said.

There are 167 Superfund sites in the EPA's Region III, including 25 in Virginia and eight in Hampton Roads.

In its statement, the Naval Shipyard said its assessments, which started in 1982, have identified eight contaminated sites that can be grouped into four areas:

- Several landfills close to Paradise Creek that were closed in 1983, including a sanitary landfill used for salvage waste, blasting grit, ash, residential trash, and sludge from the industrial waste water treatment plant; chemical holding pits; an oil reclamation area where soil was contaminated by a tank removed in 1982; a solvent disposal area; and a bermed disposal area used until the 1970s where the waste disposed of there is unknown.
- The Scott Center landfill, closed in the 1950s, which is on Paradise Creek and was used for disposal of wastes generated from drydock operations, including blasting grit, paint residues, solvents and other residues.
- A waste lime pit near the Elizabeth River, where lime sludge from acetylene manufacturing was stored until 1971.
- A metal plating shop, where soil contaminated by solutions was removed or capped in 1982.

News Release

FOR IMMEDIATE RELEASE
August 28, 1996
96-120

CONTACT: Ron Langley (206) 649-7009
Ecology Public Information
Pager: (206) 663-1785

ECOLOGY CONCERNED ABOUT HISTORY OF NAVY SPILLS

BREMERTON -- The Department of Ecology's chief regional spill responder said today that Monday's 1,300 gallon jet fuel spill from the *U.S.S. Nimitz* highlights an ongoing problem with fuel spills from naval vessels in Puget Sound.

Paul O'Brien, chief spill responder at Ecology's Northwest Regional Office in Bellevue, said Monday's spill from the *Nimitz* was the ninth significant spill from a naval vessel into Puget Sound in the past three and one-half years. He said the situation is frustrating because Ecology does not have authority to penalize the Navy for spills in Washington waters.

O'Brien said vessel commanders, not shipyard staff, are at fault. "The cleanup crew at the shipyard has done an excellent job of containing this spill and getting it off the water. That's not the problem here. Our concern is that naval vessels have significant spills on a regular basis and don't show any signs of improvement."

O'Brien noted that the shipyard has improved its spill response program in the past five years. However, vessel operations at the Bremerton facility are beyond the shipyard's control. Individual vessel commanders are responsible for spills that come from their ships.

- MORE -

The cause of Monday's spill is under investigation by the Navy. O'Brien said there has been no visual evidence of damage to fish, birds or sea mammals, but added that spills of light weight fuels like that spilled from the *Nimitz* commonly have an immediate toxic effect on tiny sea life in the upper layer of the water column.

Although Ecology does not have penalty authority over Navy vessels, it does have the authority to assess damage claims. As a result of a 1995 lawsuit filed by the state in federal court, the Navy has agreed to settle natural resource damage claims where negligence by the Navy is involved. To date, the state and the Navy have settled four claims totaling more than $6,200, while negotiations are underway on a settlement involving a 5,400 gallon jet fuel spill from the *U.S.S. Camden* in 1993. In addition, the Navy has performed a stream restoration project to compensate for damages from an additional spill at a naval facility.

Ecology and the Office of the Attorney General anticipate that natural resource damages from the most recent spill will also be resolved through a settlement if the spill resulted from Navy negligence.

Ecology and other state resource agencies have responded to numerous spills from naval vessels during the past three and one-half years. The nine largest spills are as follows:

- 1,300 gallons of jet fuel, *U.S.S. Nimitz*, Aug. 1996
- 2,500 gallons mixed water and petroleum, shipyard barge, Jan. 1995
- 150 gallons of hydraulic fluid, *U.S.S. Nimitz*, Nov. 1994
- 3,700 gallons of jet fuel, *U.S.S. Sacramento*, Oct. 1994
- 325 gallons of diesel, shipyard tug, Aug. 1994
- 200 gallons of diesel, *U.S.S. Sacramento*, June 1994
- 30 gallons of diesel, *U.S.S. Camden*, Feb. 1994
- 308 gallons of jet fuel, *U.S.S. Nimitz*, Dec. 1993
- 5,400 gallons of jet fuel, *U.S.S. Camden*, April 1993

1ST STORY of Level 1 printed in FULL format.

News Tribune

August 31, 1996, Saturday

SECTION: Local/State; Pg. B1

LENGTH: 550 words

HEADLINE: NAVY FUEL SPILLS IN PUGET SOUND FRUSTRATE STATE ECOLOGY OFFICIAL ; 1,300-GALLON ACCIDENT AT SHIPYARD MONDAY LATEST CAUSE OF FRICTION

BYLINE: Rob Carson; The News Tribune

BODY:

U.S. Navy ships spill thousands of gallons of fuel into Puget Sound each year and the state has no way to make them clean up their act, a frustrated Department of Ecology official said Friday.

Paul O'Brien, supervisor of the spill response team at Ecology's Northwest Regional Office, said Navy vessels at the Puget Sound Naval Shipyard in Bremerton have spilled nearly 14,000 gallons of fuel and other toxics into Sinclair Inlet in the past 3 1/2 years.

"The worst part is, they don't show any signs of improvement," O'Brien said. "And because of the federal supremacy clause, we don't have any authority to penalize them."

A 1,300-gallon jet fuel spill at the shipyard Monday morning so irritated O'Brien that he took the unusual step of sending out a press release criticizing the Navy's lack of responsiveness.

The Navy said 1,225 gallons of the 1,300-gallon spill were recovered in clean-up efforts.

"The shipyard and the Navy in general are continually seeking better ways to improve their spill-prevention policies," shipyard spokesman John Gordon said.

"Once the cause of this spill has been determined, anything that can be learned from it will be used to prevent spills in the future."

Monday's spill, which came from the aircraft carrier USS Nimitz, was the ninth significant spill from a naval vessel into Puget Sound since April 1993, O'Brien said.

O'Brien blamed vessel commanders, not the shipyard staff. The shipyard has improved its spill response program in the past five years and did a good job cleaning up Monday's spill.

However, vessel operations at the Bremerton facility are beyond the shipyard's control. Individual vessel commanders are responsible for spills that come from their ships.

The cause of Monday's spill remains under investigation by the Navy.

O'Brien said there has been no visual evidence of damage to fish, birds or sea mammals as a result of Monday's spill. But he noted that spills of jet fuels commonly have a toxic effect on tiny sea life in the upper layer of the water column.

Although Ecology does not have penalty authority over Navy vessels, it does have the authority to assess damage claims.

As a result of a federal lawsuit filed by the state last year, the Navy has agreed to pay natural-resource damage claims when spills are a result of negligence by the Navy.

Since then, the state and the Navy have settled four claims totaling about $ 6,200. Negotiations are under way on a settlement of a 1993 case in which 5,400 gallons of jet fuel spilled from the USS Camden.

Ecology and other state resource agencies have responded to numerous spills from naval vessels during the past 3 1/2 years, O'Brien said. The nine largest spills, according to Navy records, were:

* 5,400 gallons of jet fuel, USS Camden, April 1993.

* 3,700 gallons of jet fuel, USS Sacramento, October 1994.

* 2,500 gallons of mixed water and petroleum, shipyard barge, January 1995.

* 1,300 gallons of jet fuel, USS Nimitz, August 1996.

* 325 gallons of diesel, shipyard tug, August 1994.

* 308 gallons of jet fuel, USS Nimitz, December 1993.

* 200 gallons of diesel, USS Sacramento, June 1994

* 150 gallons of hydraulic fluid, USS Nimitz, November 1994.

* 30 gallons of diesel, USS Camden, February 1994.

LOAD-DATE: September 05, 1996

GOLOB'S

OIL POLLUTION BULLETIN

6 Sept. 1996
Vol. VIII, No. 18

The International Newsletter on
Oil Pollution Prevention, Control, and Cleanup

From World Information Systems and
the Center for Short-Lived Phenomena

News in Brief

- **Washington agency criticizes U.S. Navy for recurrent spills in Puget Sound.**

The accidental discharge of about 1,300 gallons of jet fuel from the aircraft carrier U.S.S. Nimitz on 26 August at the Puget Sound Naval Shipyard in Bremerton, Washington, is indicative of "an ongoing problem" of pollution from U.S. naval vessels in Puget Sound, according to Paul O'Brien, chief spill responder for the Washington State Department of Ecology's (DOE's) Northwest Regional Office. In a statement released after the recent spill, O'Brien noted that DOE has responded to nine spills from naval vessels at the Puget Sound Naval Shipyard during the past 3.5 years, including two other incidents involving the U.S.S. Nimitz. Although only one of the nine incidents resulted in the spillage of more than 5,000 gallons of oil, O'Brien noted that DOE is concerned about the "emerging pattern of recurrent spills" from naval vessels in Puget Sound. However, he also said that the spills are the responsibility of the vessel commanders, not personnel at the shipyard in Bremerton, and that the shipyard has improved its spill response procedures during the past few years. "The cleanup crew at the shipyard did an excellent job of containing the recent spill and getting it off the water," O'Brien said. "That's not the problem here." Rather, "our concern is that naval vessels have significant spills on a regular basis and don't show any signs of improvement," O'Brien exclaimed. He told OPB that DOE is "frustrated" because it does not have authority to penalize the U.S. Navy for spills from naval vessels. According to O'Brien, the recent spill from the Nimitz, like most of the spills from naval vessels in Puget Sound during recent years, was caused by human error. "We would like the Navy to place more emphasis on preventing these operational spills," O'Brien said. "On a ship like the Nimitz, with several thousand crew and many complicated operations going on at once, spill prevention is not easy, but it is still necessary," O'Brien concluded.

Oil Spills in Washington State: *A Historical Analysis*

WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

April 1997
Publication No. 97-252
Printed on Recycled Paper

Department of Ecology
Spill Management Program

Oil Spills in Washington State: A Historical Analysis

April 1997, Publication #97-252

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Dave Lundstrom and **Steve Hunter**, Section Supervisors, *Spill Management Program*

Prepared by: **Jon Neel, Curt Hart, Donna Lynch, Steve Chan** and **Jeanette Harris**
Central Programs — Spill Prevention and Policy Section

Cover Photo:
The tank vessel Mobil Oil grounded on Warrior Rock in the Columbia River on March 20, 1984. Rudder failure from improper maintenance was the cause of the accident. After losing 200,000 gallons of heavy oil, this photo shows how other vessels were used in an attempt to lighten and refloat the tanker. *Photo by Jon Neel*

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Introduction

Twenty-two years have elapsed since the Department of Ecology first proposed establishing a comprehensive oil spill prevention and response program in Washington State. The 1975 legislative proposal was prompted after the state suffered major oil spills. Another concern at that time was that the brand new Alyeska pipeline would dramatically increase oil tanker traffic in the Puget Sound. Although the Alaskan pipeline spurred major refining activity in Washington, the proposed environmental protection program never materialized due to lack of funding. Even though no one wanted spills to occur, the full public cost of oil spills was not placed completely on the shoulders of those responsible for transporting oil. The oil spills kept occurring.

It took a series of major oil spills in Washington and Alaska in the late 1980s and early 1990s before Washington's innovative spill prevention and response program was finally put into place by the Legislature. These major spills include:

- The 1985 *ARCO Anchorage* tanker spill in which 239,000 gallons of crude oil was released into marine waters at Port Angeles;
- The 1988 *Nestucca* barge spill which released 231,000 gallons of fuel oil into waters along the coast of Grays Harbor ;
- The disastrous 1989 *Exxon Valdez* spill in Alaska which unleashed 11 million gallons of crude oil into Prince William Sound;
- The 1991 Texaco refinery spill at Anacortes which released 130,000 gallons of crude oil, of which 40,000 gallons went into Fidalgo Bay; and
- The 1991 spill at the U.S. Oil refinery in Tacoma which involved 600,000 gallons of crude oil, most of which was stopped from entering state waters.

How these and other major oil spills accelerated state and federal oil spill prevention, preparedness and response legislation is outlined in **Appendix 2**. This outline shows how the major preventable spills between 1985 and 1992 resulted in innovative legislation which holds potential spillers accountable for preventing and cleaning up spills.

Washington's oil spill prevention and response program has been in place for six years. This report is an examination of the history of oil transportation and the resulting trends in oil spills. This analysis is the first step toward measuring the level of success that industry, government and the public are having on preventing oil spills. This report is also intended to help Washington determine how to best provide the "best achievable protection" from the effects of oil spills while assuring that federal and state programs complement each other.

This report provides partial answers to the following fundamental questions:

- What fundamental forces have shaped state policy regarding oil transportation and spills?
- Has Washington's additional attention to oil spill prevention and response paid off?
- Given Washington's recent increased refinery production, increased pipeline traffic and expanded Pacific Rim trade: How does our state's record of recent spills compare with national and international trends?
- Should the state make any adjustments in its program as a result of these trends?

Chapter 1: Washington State Energy Policy and Oil Spill Initiatives

Washington's unique physical geography coupled with its abundance and diversity of natural resources has been the driving force behind how the state has provided for its energy needs and how much importance the state has placed on preventing and responding to environmental threats, especially oil spills.

Located at the northwest corner of the continental United States, Washington's rugged mountain terrain and distance from traditional energy sources prompted the state to develop its own energy reservoirs. Since the 1930s, Washington has exploited its hydroelectric resources and these dams have, in many ways, become the region's energy backbone.

The Puget Sound is also the closest national port in the lower 48 states for vessels carrying crude oil out of Valdez, Alaska. For more than 25 years, tankers laden with Alaskan crude oil have brought their precious cargo into Washington. Even though the state produces none of its own oil, Washington has the fifth highest refining capacity of any state in the nation. The waters of Washington State are also one of North America's primary water-borne transportation avenues for Pacific Rim commerce. A visitor to one of Washington's busy ports will see many ships flying flags from Russia, China, Japan, Korea, Malaysia and a variety of other nations.

At the same time, Washington's waters and shorelines contain highly sensitive and valuable natural resources. State marine waters contain critical commercial resources including fishing, crabbing, shrimping and shellfish industries. Washington is also blessed with abundant and diverse fish and wildlife resources which are a driving force in state tourism and provide recreational opportunities for residents. The seabird colonies along Washington's outer coast are among the largest in the United States. In addition, 29 species of marine mammals — including whales, dolphins, seals, seal lions and sea otters — breed in or migrate through the state. The Olympic Coast is the least disturbed major section of coastline in the continental lower 48 states and, according to the Office of Marine Safety and U.S. Coast Guard, it is also the area in Washington that is at greatest risk of experiencing a major vessel oil spill.

Given the importance of preventing spills, this report explores the important connection between historical oil spill information and spill trends, and identifies general areas where non-regulatory approaches for spill prevention might be viable. Effective spill prevention can best be attained through the right mix of regulatory and voluntary compliance initiatives. As state regulatory programs have matured, Ecology has been shifting its focus to educational initiatives. The information on spill trends in this report is part of this effort.

Measuring the effectiveness of state spill prevention endeavors is very complex. Most experts agree that while human factors of one type or another underlie most incidents, spills occur from a wide variety of specific sources and causes. Specific technological or procedural changes must be developed and implemented to eliminate or minimize the occurrence of these incidents. If we are to continue making good progress in preventing spills, it is imperative that we gather better information on actual spills to understand these incidents. This report is also an effort to obtain and disseminate this information.

State Oil Spill Policy: A Historical Overview

Prior to the mid-1940s, most Washington communities discharged raw sewage into state water bodies, most industrial wastes went untreated and small oil spills were accepted as part of doing business. As a result of continued population growth, state harbors, rivers, lakes and streams quickly became polluted. In March 1945, the Legislature established the Pollution Control Commission. In order to give the commission real authority, lawmakers also passed legislation prohibiting the pollution of any waters of the state and established specific penalties for violations.

In 1955, the Legislature passed a new law which required that any "commercial or industrial operation of any type which results in the disposal of solid or liquid waste material into the waters of the state shall procure a permit" from the Pollution Control Commission. This state act preceded the federal Water Pollution Control Act by 10 years. In several instances, Washington State environmental laws have been models for federal pollution laws.

Growth of Washington Oil Industry

Prior to 1950, there were no refineries and very little crude oil was transported into Puget Sound. In 1953, the Trans-Mountain Pipeline Company and Mobil Oil announced their plan to construct an oil pipeline from British Columbia into Washington. A year later, the state received its first delivery of Canadian crude oil. Most of Washington's refineries were constructed in the 1950s, including:

- 1954 — Mobil Oil refinery, Ferndale (now owned by Tosco);
- 1955 — Shell Oil refinery, Anacortes;
- 1957 — US Oil refinery, Tacoma; and
- 1958 — Texaco refinery, Anacortes.

In 1958, a high tariff imposed by Canada on the Trans-Mountain Pipeline resulted in a 12-18 month embargo on oil imports from British Columbia. This and other events led to concerns about the long-term stability of the Canadian supplies. In order to improve the oil transportation system, the Olympic Pipe Line Company built its pipeline in 1966 and began delivering petroleum products from the refineries in the north part of the state to consumers in Seattle, Tacoma and Olympia in Washington, and to Portland and Eugene in Oregon.

Developments Related to Alaskan Oil

In 1968 and 1969, the Alaska North Slope oil fields were discovered at Prudhoe Bay. In anticipation of the movement of Alaskan oil into Washington and other pressing environmental concerns, the Legislature passed a series of environmental and spill-related laws.

In 1970, the Washington State Legislature established the Department of Ecology, followed quickly by the passage of the 1971 Washington Oil Pollution Act which:

- Established unlimited liability for oil spills;
- Provided for state cleanup capability; and
- Specifically clarified that the discharge of any oil into state waters was illegal.

That same year, Governor Dan Evans requested an oil risk analysis report concerning the transportation of oil into Puget Sound. Also in 1971, ARCO built its Cherry Point refinery near Ferndale. This move put state production of petroleum products well ahead of in-state consumption. It also greatly increased tanker traffic into Puget Sound.

Construction of the Trans Alaska Pipeline System (TAPS) began in 1973 after the U.S. Congress passed the Trans Alaska Pipeline Act. However, in October 1973 the Organizations of Petroleum Exporting Countries (OPEC) placed an embargo on oil exports to the United States. The resulting shortage placed additional national attention and reliance on Alaskan North Slope oil.

In Washington, one of the results of the embargo was that in 1975 the Northern Tier Pipeline Company proposed constructing a major oil pipeline originating in Cherry Point near Ferndale and terminating in Minnesota. In January 1976, Northern Tier changed its proposed point of origin from Cherry Point to Port Angeles.

Also in 1975, the Legislature passed the Washington Tanker Safety Act which prohibited tankers exceeding 125,000 dead weight tons from entering Puget Sound, and required tug escorts and pilots for certain other tankers. In 1978, the U.S. Supreme Court invalidated this "supertanker" ban in the case of *ARCO vs. Governor Ray*. The court found that federal law pre-empted Washington from banning large tankers, but affirmed the right of the state to establish tug escort and other requirements. U.S. Senator Warren Magnison later re-established supertanker limits through federal legislation.

In the 1970s, the Department of Ecology completed a number of shoreline sensitivity studies focused on the San Juan Islands in anticipation of the influx of Alaskan oil. The studies were undertaken in order to establish a "baseline" so that any environmental changes precipitated by a major oil spill could be more readily quantified. In both 1972 and 1975, Ecology proposed creating a state spill prevention and response program but could not secure funding from the Legislature for the effort. It took a series of major spills in the late 1980s and early 1990s to provide the impetus to establish and fund a state comprehensive spill prevention, preparedness and response program (see **Appendix 2**).

In June 1976, a federal Coastal Zone Management law placed a partial prohibition on the expansion of existing oil terminals. However, this provision may be superseded by other federal laws. That same year, Washington also established the Energy Facility Site Evaluation Council (EFSEC) whose mission was to oversee the siting and permitting of energy facilities such as pipelines, refineries and nuclear power plants. The council held extensive hearings on the Northern Tier Pipeline proposal. The pipeline project was not approved.

Recent Developments

During the late 1970s, EFSEC certified the siting and construction of five Washington Public Power Supply System (WPPSS) nuclear power plants. Three developments — the subsequent demise of four of these five plants, the WPPSS bond default and the shut down of the federal "N" reactor at the Hanford Nuclear Reservation — assured the state's continued reliance on hydropower and fossil fuel resources, including oil and coal for use in the Centralia power plant.

In 1990, the Trans Mountain Pipeline Company proposed constructing an oil terminal at Low Point east of Port Angeles on the Olympic Peninsula. The proposal included two single-point mooring buoys, a tank farm at Low Point, and a pipeline which would be located under Puget Sound and connect the Low Point facility with refineries located at Anacortes and Ferndale. The project would have eliminated most tanker traffic coming into Puget Sound beyond Port Angeles, but was eventually withdrawn as a result of public environmental concerns and lack of support from the oil industry.

Even with the state's relative isolation from continental U.S. energy supplies, its oil markets are not immune to the market effects of Mideast oil supply volatility as seen during the 1973 OPEC embargo. On Dec. 11, 1996, the United Nations again allowed the sale of Iraqi oil on the international market as a result of humanitarian pressures. This action is expected to lower the consumer price of refined petroleum products throughout the United States.

Current Regulatory Framework

Ecology has been involved in preventing and responding to spills since the agency was formed in 1971. The agency's spill response capability prior to 1989 consisted of a team of employee volunteers in each of the four regional offices whose main area of expertise lay in other program areas. There was little centralized management of spill activities. As a result of the drawbacks associated with this decentralized response system and the identification of additional funding, Ecology centralized the spill organization in 1990.

These changes and the legislation which passed from 1989 to 1992, resulted in the state spill program which continues to evolve to this day with centralized management systems and regional service delivery. Ecology is now responsible for:

- Preventing spills at oil handling facilities;
- Managing the state's preparedness efforts;
- Responding to oil and hazardous material spills statewide; and
- Coordinating state natural resource damage assessment activities.

The U.S. Congress passed the Oil Pollution Act in 1990 (OPA 90). This statute created new national standards for oil spill prevention and response in the wake of the Exxon Valdez spill. Congress delegated responsibility for implementing most of OPA 90's provisions to the Coast Guard, Environmental Protection Agency, Department of Transportation's Office of Pipeline Safety, National Oceanic and Atmospheric Administration and the Minerals Management Service.

The Washington State Office of Marine Safety (OMS) was created in 1991 by the Legislature to provide further assurance that frequency of oil spills would be reduced. OMS is responsible for preventing vessel oil spills through vessel inspections, investigation of marine casualties, enforcement of state maritime standards and by approving vessel spill contingency plans.

State and Federal Relationships

Washington's role in the current state-federal framework for regulating the oil industry is complicated because each major federal regulatory agency views the role of the state differently. Some independent legal analysts believe that the U.S. Coast Guard attempts to promote uniformity by establishing "ceilings" for regulatory requirements, while the U.S. Environmental Protection Agency uses federal environmental laws to set "floors" which allow states to set more stringent requirements if they are necessary for regional considerations. Major oil pipelines are regulated by the U.S. Department of Transportation's Office of Pipeline Safety. This agency generally sets ceilings. However, unlike the EPA and Coast Guard, the Office of Pipeline Safety delegates some of their spill prevention authority to states that have established effective regulatory programs.

Some of these federal agency policy differences concerning state program consistency can be traced to concerns for interstate uniformity regarding transportation systems such as vessels, trucks and airlines. However, these interstate concerns may not be valid when states establish regional standards for fixed facilities and do not impede interstate commerce. Questions remain regarding EPA and the Coast Guard delegation of programs to states and why fixed interstate pipelines should not be subject to state spill prevention standards if interstate commerce is not impeded. These issues are particularly relevant when the current congressional view of states rights' seems to be reducing federal regulatory programs in favor of state control. However, at this time federal law does not provide a mechanism for state delegation.

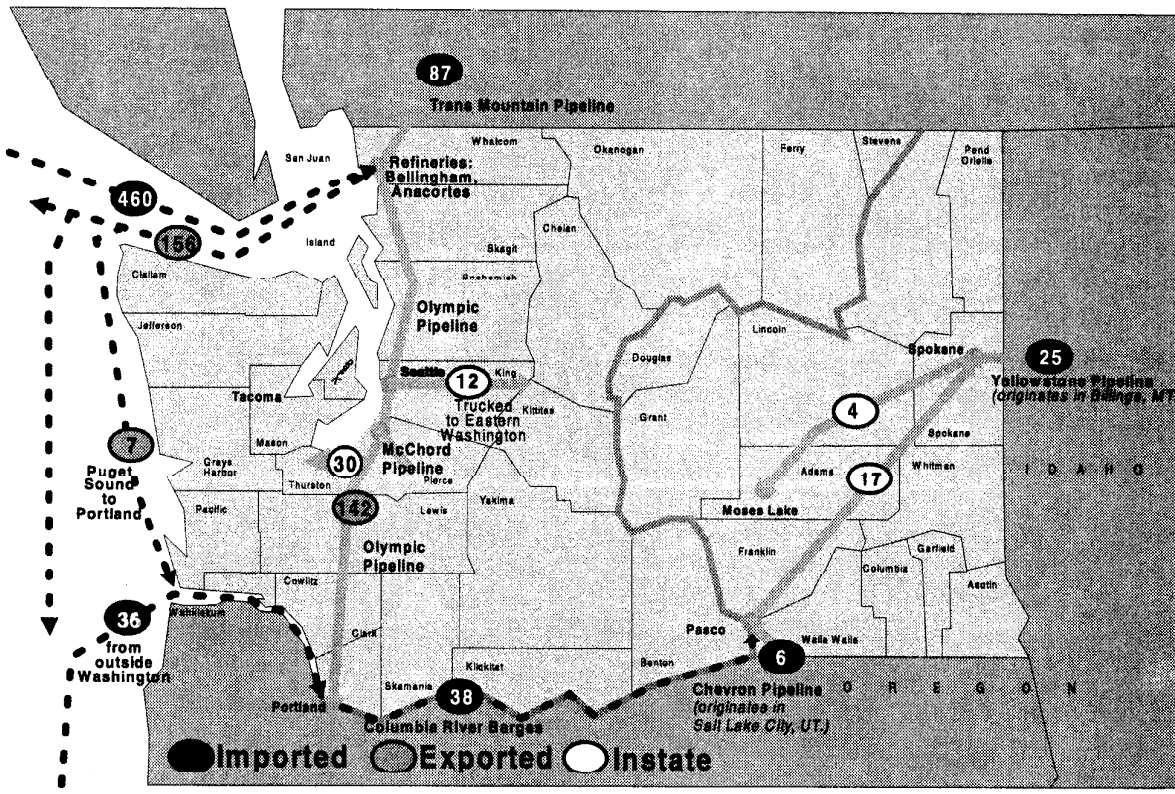
These differences in regulatory approach do not apply to spill preparedness and response. EPA and the Coast Guard have established strong and effective cooperative mechanisms with respect to state co-management of spill responses while minimizing duplication.

Current Oil Transportation Patterns and Related Spill Risks

As one of North America's major gateways to Pacific Rim trade, Puget Sound is one of the busiest waterways in the world with vessel traffic going to several busy ports in Washington State and to major facilities in Vancouver, British Columbia. More vessel tonnage moves through the Strait of Juan de Fuca than through the combined ports of Los Angeles and Long Beach, California.

Washington is also one of the nation's primary petroleum refining centers. Refined products are exported from Washington to other western states, such as Oregon and California, primarily through pipelines, barges and tankers. There are five major pipelines in Washington: Trans Mountain, Olympic, McChord, Chevron and Yellowstone. The primary transportation routes and quantities of oil transported are shown in **Figure 1**. The map shows the enormous quantities of crude oil and refined products which are transported through our coastal areas, Puget Sound and the Columbia River by tankers and barges.

Figure 1 — Oil Movement in Washington State (figures in thousands of barrels a day)



The vessels in-bound to Puget Sound are primarily moving crude oil to Washington's refineries. Large quantities of crude oil also come into our refineries through the Trans Mountain Pipeline. Refined petroleum products are moved to in-state consumers primarily by pipelines and trucks. These transportation corridors constitute the areas at greatest risk of major spills. Significant elements of major spill risk which are not indicated on the map include: cargo and passenger vessels in Pacific Rim trade; large facilities with piping and storage tanks; and rail/tanker truck traffic.

Production in the Alaskan North Slope oil fields has declined over the last few years as the proven reserves are drawn down. However, it is not clear at this time whether this trend will continue, as projected recently by the Oil and Gas Journal, or whether new finds and improved production techniques will stabilize production as believed by some industry analysts. The long-

term effect of changes in Alaskan oil production on Washington refineries remains to be seen. One of the current effects of the reduced North Slope oil supply is that oil importation from Canada through the Trans Mountain Pipeline has dramatically increased in recent years. The Office of Marine Safety data indicates that the number of individual tankers moving oil into Washington waters was:

- 907 in 1993;
- 908 in 1994;
- 723 in 1995; and
- 804 in 1996.

This data includes tank ships bound through Washington waters to Puget Sound ports, the Columbia River, Canadian ports and Grays Harbor.

Chapter 2: Oil Spill Data Sources

The spill related information in this report is divided into two sections for the purpose of presenting a clear analysis. ***Chapter 3: Major Oil Spills in Washington*** deals with well documented facility, pipeline, vessel and surface transportation spills greater than 10,000 gallons that have occurred since 1970. ***Chapter 4: Recent Trends in Oil Spills*** takes a closer look at all oil spills between 25 and 10,000 gallons that have occurred in the last four years — with the exception of surface transportation (railroad and truck) spills.

Ecology began consistently keeping records of oil spills only after the Legislature provided dedicated funding for the program in 1991. Prior to this time, readily accessible records are incomplete. Fortunately, the agency has institutional memory and information relating to larger spills, particularly those exceeding 10,000 gallons. In preparing this report, a range of sources were reviewed to fill in data gaps. With respect to recent spills (discussed in **Chapter 4**), the information should be accurate given the careful data collection efforts of Ecology's spill and damage assessment team for spills of over 25 gallons reaching surface waters. Spill information is stored in the agency's Environmental Report Tracking System (ERTS) database and a small "stand alone" database for major spills.

Information on specific spills in this report could contain inaccuracies. For example, there is often a tendency by those responsible for a spill to under report the amount of product spilled. No potential systematic errors in the data have been identified other than the possible under reporting of spill volume. Accurate information on the root cause of past spills was also difficult to obtain. Therefore, a smaller data set was used to evaluate spill causes.

Data for land transportation (truck and rail) spills has not been included in the analyses of recent spills because of a lack of complete information about this industry segment. However, land transportation spills do represent a serious threat. Staff from Ecology's regional office located in Yakima have reported that tanker truck accidents have resulted in multi-thousand gallon spills with some regularity over the years. These tanker truck spills pose a significant threat to public health and safety in addition to environmental damage. These inland fuel spills can contaminate drinking water, create dangerous fumes, pose a fire threat and result in fresh water fish kills.

Unless otherwise noted, the figures in this report do not include information on leaking underground storage tanks (LUST) or from spills of animal or vegetable oil.

Ecology intends to use the information contained in this report as environmental quality indicators to help measure the state's success in preventing spills. The information will also help the agency target its facility spill prevention efforts. The agency will continue tracking and reporting spill information and appreciates receiving additional information regarding spill history and trends from all sources.

Chapter 3: Major Oil Spills in Washington

This section evaluates information on major spills of 10,000 gallons or more which have occurred in Washington since 1970.

Distribution of Major Spills

The historical trends in the annual volume of oil spilled each year from major incidents are a key indicator of the state's success in preventing major spills. According to the *Oil Spill Intelligence Report*, the annual average volume of oil spilled worldwide from oil spills greater than 10,000 gallons during the five year period 1987-91 was 53 million gallons (excluding the 1991 Persian Gulf war related causalities). However, the annual average volume of oil spilled at major oil spills during the four year period 1992-95 was 75 million gallons worldwide — a 41 percent increase.

The "1995 International Oil Spill Statistics" compiled by the *Oil Spill Intelligence Report* concluded that despite the considerable efforts to reduce spills, a downward trend in the number of large spill incidents worldwide "is probably not occurring."

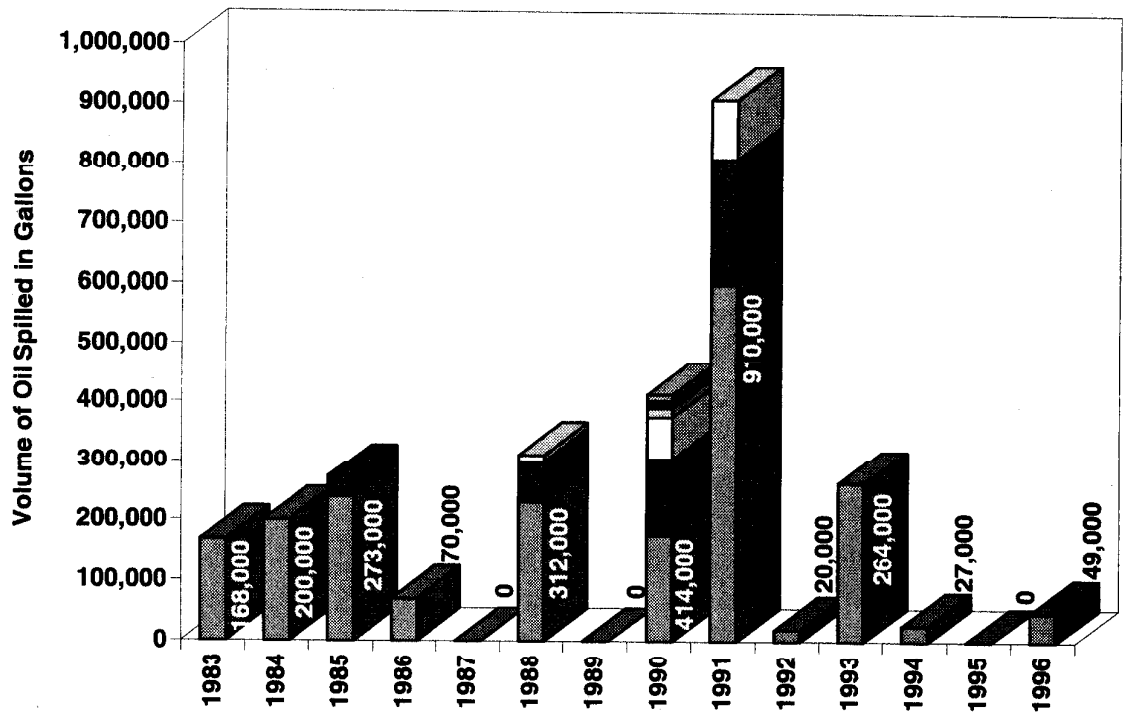
The data in **Figure 2** displays the annual amount of oil spilled in Washington State from spills larger than 10,000 gallons. As seen in this figure, the amount of oil spilled per year as a result of major incidents appears to be declining in Washington during the last five years. Although there is not enough data to evaluate the trends statistically, it does appear that the volume and incidence of major spills in Washington State may be declining more abruptly than that indicated by national and international trends.

The year Washington passed its major oil legislation (1991), we experienced 3 major spills over 10,000 gallons. During this apparently anomalous year, incidents resulted in the loss of 100,000 gallons from the Tenyo Maru; 600,000 gallons from US Oil and Refining; and 210,000 gallons from Texaco refining.

The annual average volume of oil spilled in Washington State from petroleum oil spills greater than 10,000 gallons during 1987-91 was 327,000 gallons. The volume of oil spilled during the five-year period from January 1992 through June 1996 was 72,000 gallons — a 78 percent reduction. Both Ecology and the state Office of Marine Safety's spill prevention and response efforts were fully funded and staffed by June 1992. However, one should be cautious when interpreting the significance of these trends in relation to the effectiveness of the state's program given:

- The highly variable nature of the data (especially spills during 1991);
- The fact that spill incidents have a higher probability of being reported in more recent years;
- The fact that spill volumes are more accurately reported now; and
- The regulatory programs of the Coast Guard and EPA under the federal Oil Pollution Act of 1990, while not visibly affecting national trends may have had a regional effect.

Figure 2 — Major Oil Spills in Washington State Over 10,000 Gallons: Volume of Spills Per Year in Gallons



The cause and effect of such broad trends cannot easily be determined in a complex milieu such as spill prevention. Factors which weigh heavily in determining outcomes include human considerations such as legal liability, criminal liability and corporate philosophy. Non-human considerations include weather patterns, environment and sea conditions. Furthermore, a single catastrophic spill such as the *Exxon Valdez* can significantly skew the data.

However, with these limitations in mind, Ecology attributes this apparent decline in the volume of oil spilled in Washington from major incidents to a broad effort by industry, the public sector and public interest groups to prevent these incidents. In addition to the efforts by state agencies:

- The major oil refineries and marine terminals have enhanced corporate policies, developed more effective spill prevention and response plans, improved personnel training and dedicated more resources to equipment maintenance among other initiatives;
- Oil tanker and regional tank barge operators have invested heavily in clean-up equipment and personnel improvements — including procedures, training, crew rotation and spill response equipment;
- The domestic cargo vessel industry has placed a much higher priority on spill prevention than in the past;
- The Coast Guard has enhanced the vessel traffic system;
- In the Northwest, the Coast Guard and EPA have been very active in implementing the federal Oil Pollution Act of 1990; and
- The efforts by local government, tribes and environmental groups have been particularly important in keeping private and public sector stakeholders focused on effective prevention measures.

While this data relates to volume, it does appear to be consistent with trends identified in national spill statistics by American Petroleum Institute (API). API concluded that during the decade ending in 1994, the *frequency* of large spills declined by 57 percent.

Source of Major Spills

Figures 3 and **4** display the number of vessel, facility and transmission pipeline spills in the database. As previously mentioned, data on spills from surface transportation modes, such as rail and truck, has not been consistently collected and therefore was not included in the statistics.

Figure 3 — Major Oil Spills Over 10,000 Gallons: Number of Spills by Source

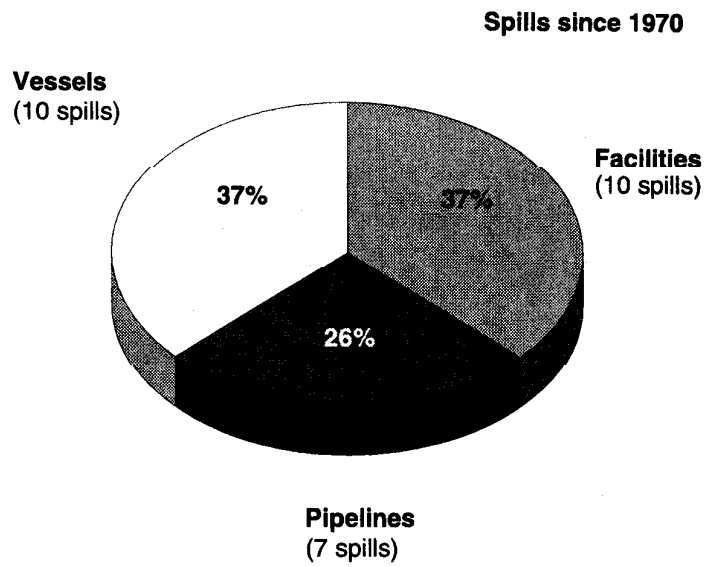
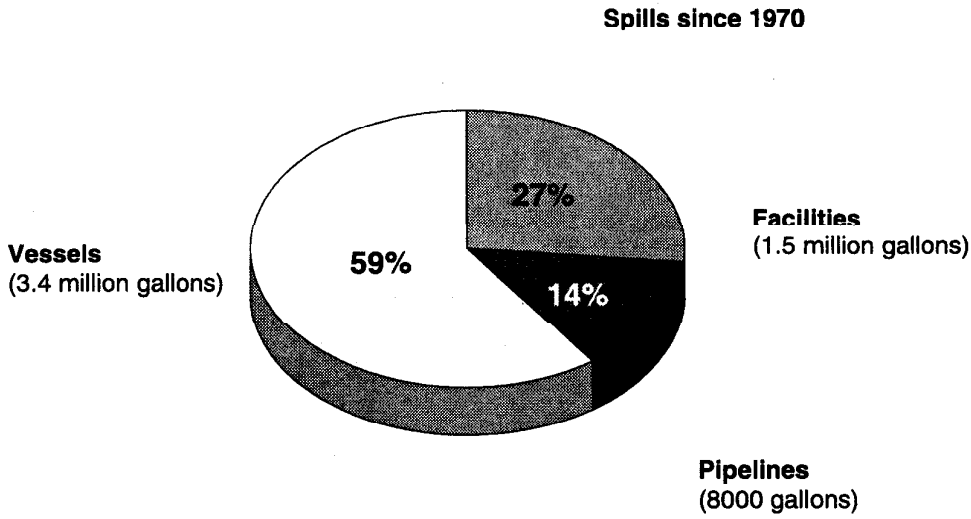


Figure 4 shows the volume of oil spilled from the marine industry (3.4 million gallons) is larger than that spilled by facilities and pipelines (2.3 million gallons). The two figures combined indicate that the size of major vessel spills exceeds that of facility and pipelines. This data is heavily influenced by several large volume marine accidents which have occurred on the coast and in the Strait of Juan de Fuca.

The data indicates that major pipeline spills are generally smaller than major vessel or major facility spills. However, as discussed later in this report, there has been a recent series of major pipeline spills.

The American Petroleum Institute has concluded that "large spills of 10,000 gallons or more accounted for nearly 90 percent of the total oil spilled during the last decade." State data appears to support this conclusion.

Figure 4 — Major Oil Spills Over 10,000 Gallons: Total Volume of Oil Spilled by Source



Types of Oil Spilled

Figures 5 and **6** display information on the number and volume of oil spilled by product type. The figures show that heavy fuel and crude oils, which are the most environmentally damaging types, are the largest amount of oil spilled in the state. These viscous "black" oils have a tendency to smother animals such as birds and mammals, often killing them. These oils are also highly persistent and create residues which are resistant to natural physical and biological degradation processes.

Figure 5 — Major Oil Spills Over 10,000 Gallons: Number of Spills by Type

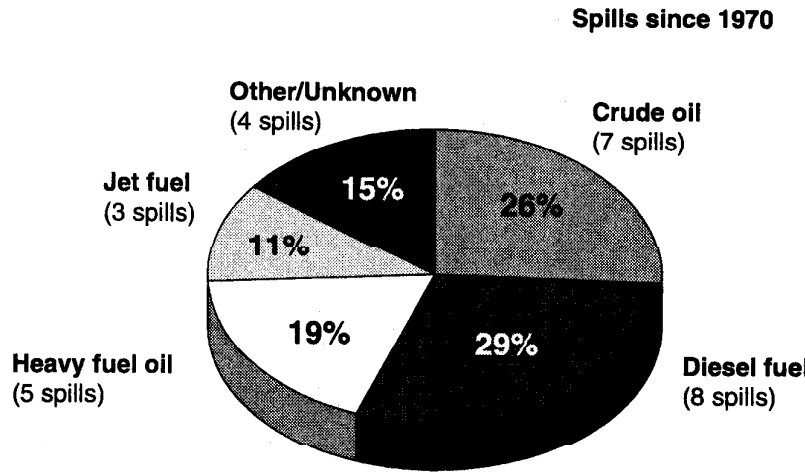
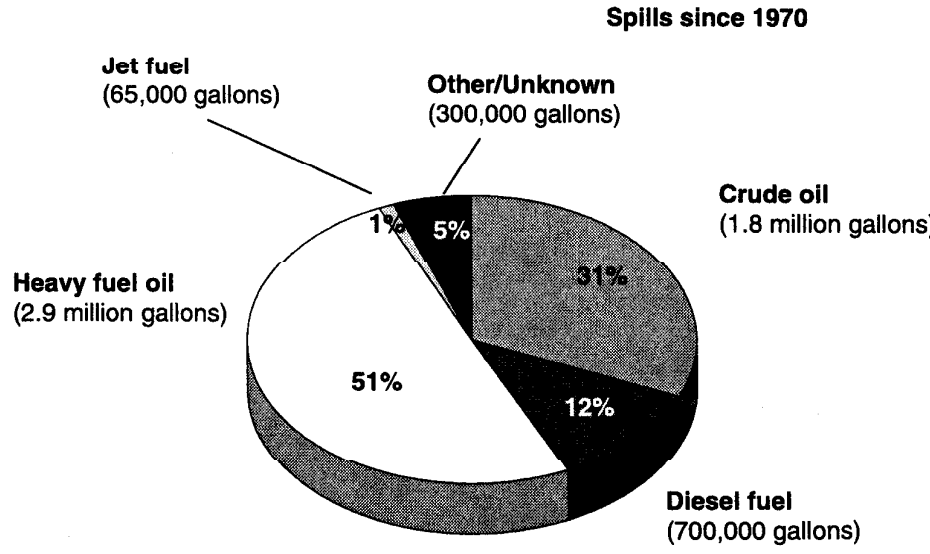


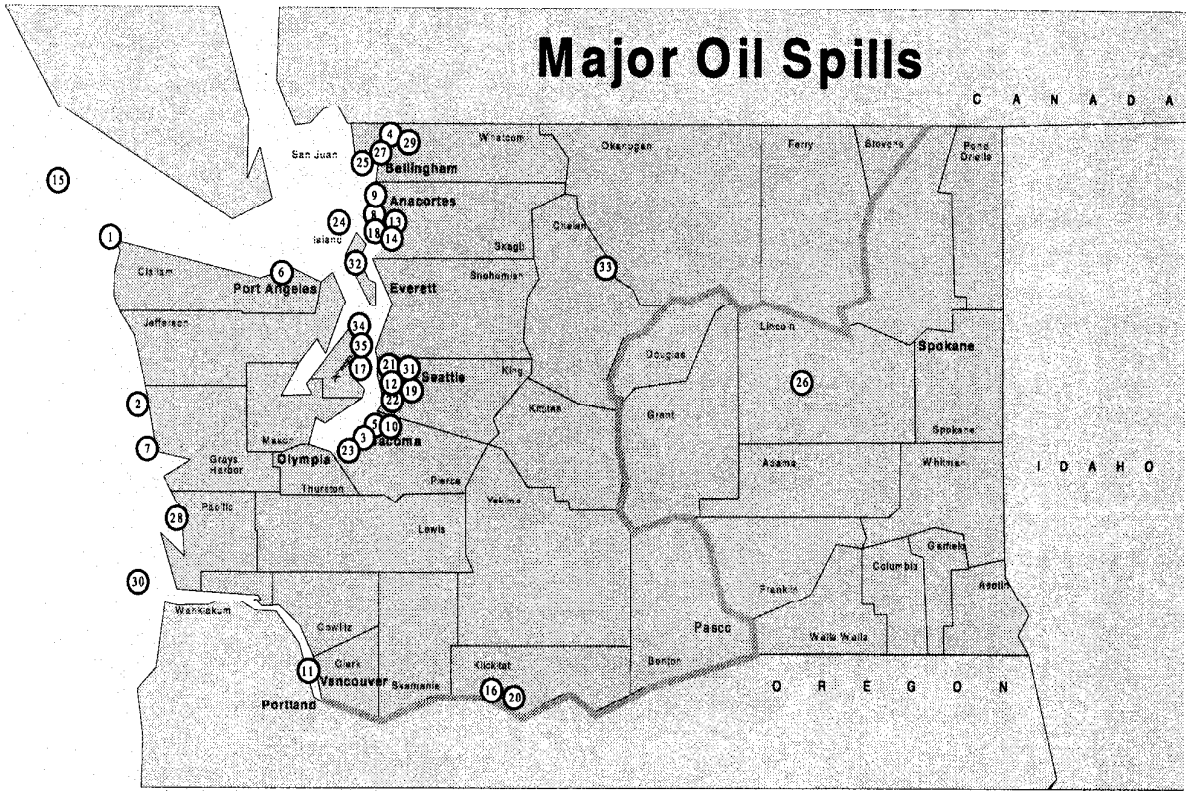
Figure 6 — Major Oil Spills Over 10,000 Gallons: Volume of Oil Spilled by Type



Geographical Distribution

Figure 7 is a map of the state showing the locations of the major spills, and includes additional spills not analyzed in **Figures 2-10**. The additional spills are noted in **Appendix 4**. The map shows a clustering of large spills in Puget Sound and dispersed along the coast and Strait. **Appendix 4** provides a detailed list of these spills.

Figure 7: Location of Major Oil Spills Over 10,000 gallons



Figures 8 and **9** show the distribution of the number and volume of major oil spills in Ecology's four regional offices. A map depicting the jurisdictional boundaries of each regional office is found in **Appendix 5**. More oil was lost from major spills in the agency's southwest regional office than the three other regions combined. This is likely due to this region's long marine shoreline which encompasses all of the state's Pacific coast line, the Strait of Juan de Fuca and much of Puget Sound.

Figure 8 — Major Oil Spills Over 10,000 Gallons: Number of Spills by Regional Office

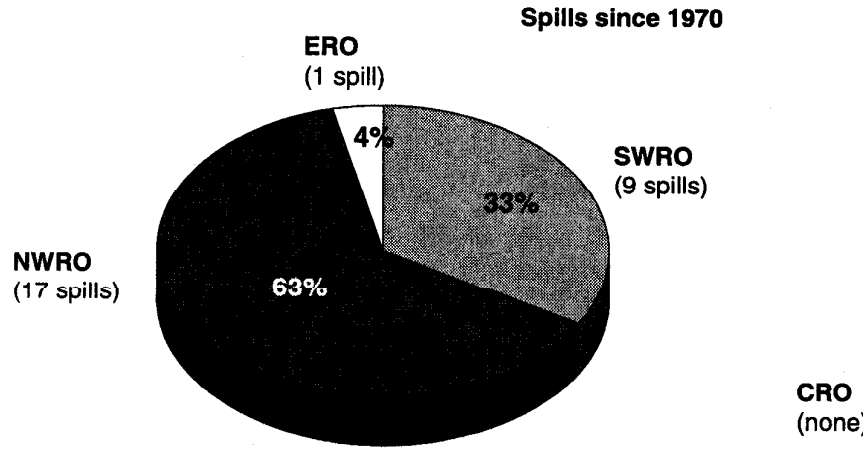
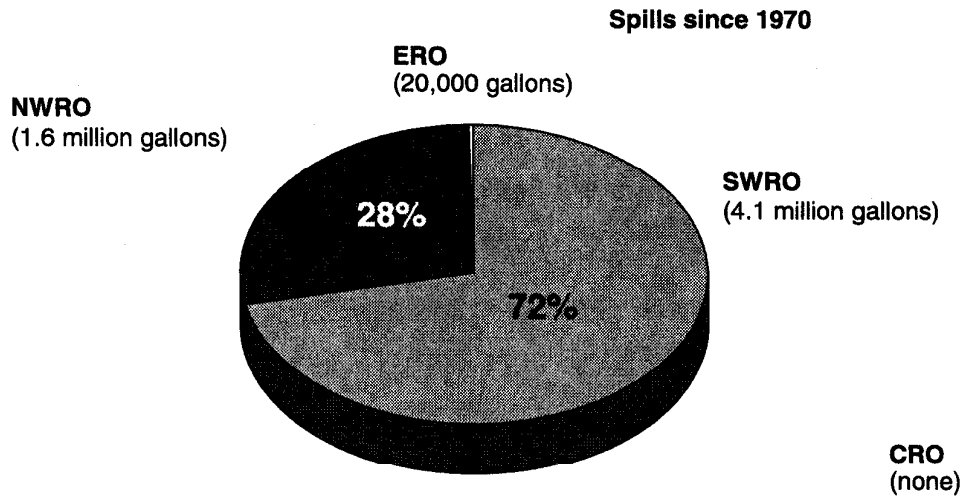


Figure 9 — Major Oil Spills Over 10,000 Gallons: Volume of Spills by Regional Office

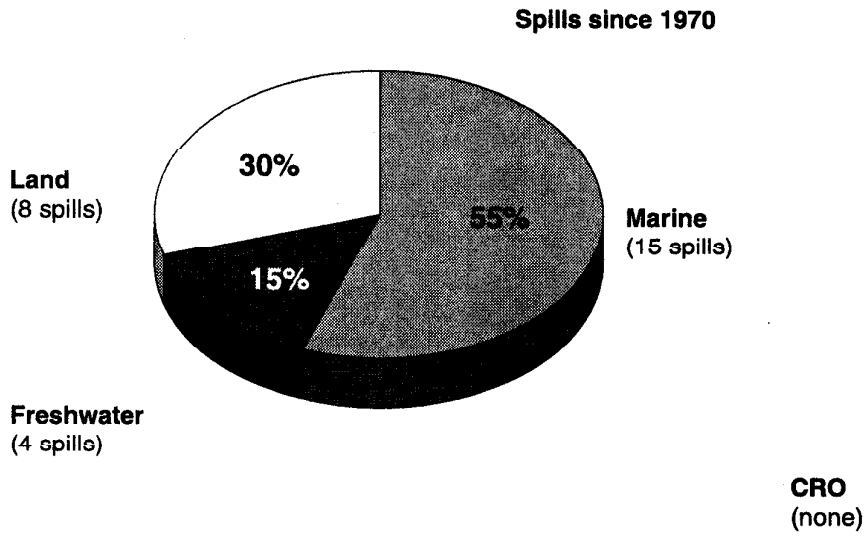


While the largest spills occurred in the SWRO, the northwest regional office (NWRO) actually received more spills greater than 10,000 gallons. This is due to the large population and activity levels centered in Seattle, Bremerton and, to a lesser extent, the northern refineries.

The data probably under represents the volume and number of spills in the Central (CRO) and Eastern (ERO) regions because surface transportation incidents were not included in the analysis. CRO has reported the greatest number of multi-thousand gallon petroleum product spills from tanker truck rollovers. Winter mountain pass conditions undoubtedly contribute to the number of truck accidents.

Figure 10 shows the distribution of spills by receiving environment. Slightly over half of the spills effected the marine environment. In 45 percent of the major spills, impacts were primarily limited to freshwater habits and the land. While land spills often have a lower degree of impact on the environment they can have serious consequences upon public health if they affect drinking water wells, and to public safety if gasoline fills buildings with explosive and/or toxic vapors.

Figure 10 — Major Oil Spills Over 10,000 Gallons:
Number of Spills by Impacted Medium



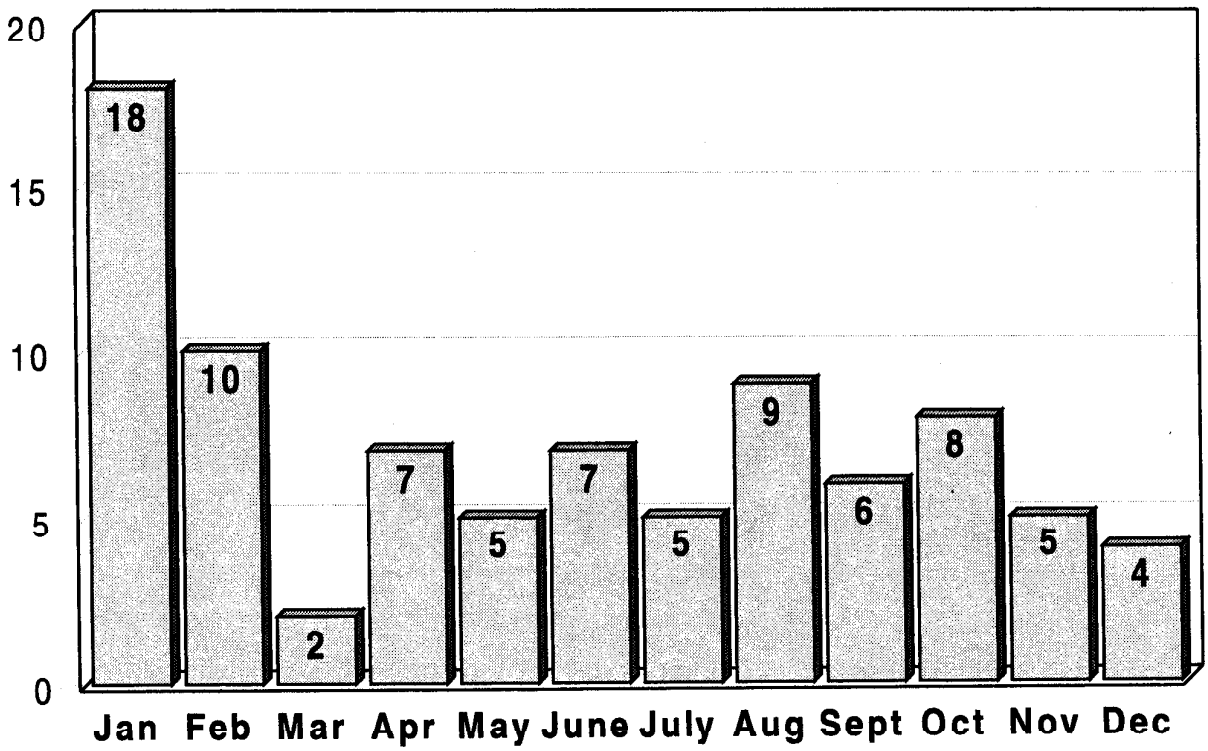
Chapter 4: Recent Trends in Oil Spills

This section evaluates information on spills between 25 and 10,000 gallons which have occurred between June 30, 1992, and July 1, 1996. The spills included in this data set include 86 vessel and facility spills and six pipeline spills where at least 25 gallons of oil reached water or at least 250 gallons was spilled on land. Truck and train transportation incidents are not included in this data.

Distribution of Recent Spills

Figure 11 compresses the most recent four years of facility and vessel spill data into a single 12 month bar chart. While we must be careful in not over interpreting the graph given the relatively few data points in each month, it does appear that spill frequency peaks during January. This phenomena has been observed by others and may be explained by probability of human error increasing during cold, dark climatic conditions and the holiday season.

Figure 11 — Distribution of Oil Spills Over Time: Number of Vessel and Facility Spills by Month
(pipelines not included)



Source of Recent Spills

As shown in **Figures 12** and **13**, our information indicates that for these medium sized spills, the number of vessel incidents is significantly larger than the number of facility and pipeline incidents combined. The volume of oil spilled from the marine industry is also large compared with facilities and pipelines.

Figure 12 — Recent Spills 25 to 10,000 Gallons: Number of Oil Spills by Source

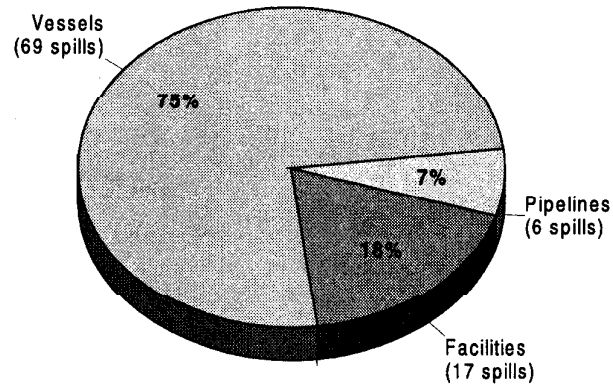
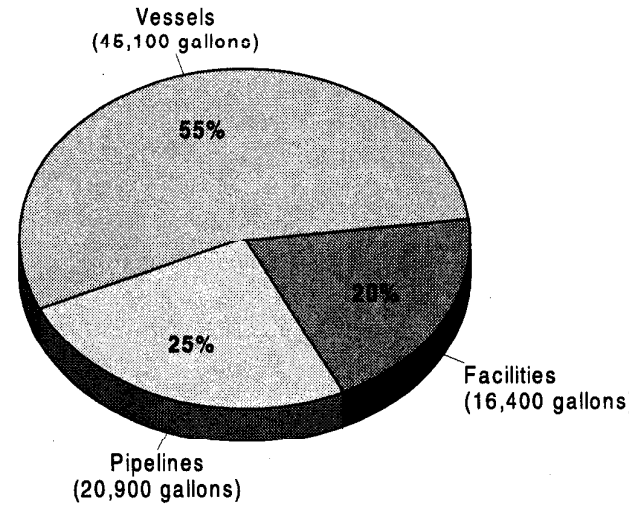


Figure 13 — Recent Spills 25 to 10,000 Gallons: Volume of Oil Spilled by Source



Overall, there are a relatively large number of medium sized vessel diesel fuel spills. However, another observation is that pipeline spills tend to be larger than vessel or facility spills (see **Figure 13**) for this data set. While pipelines account for only seven percent of the spill incidents, they resulted in 25 percent of the volume of spilled oil.

Types of Oil Spilled

Figures 14 and **15** describe the number and volume of oil spills by product type. In contrast to the major spills which were dominated by heavy fuels and crude oil, diesel spills dominate the number and volume of recent medium-sized spills. In this data set, crude oil spills are relatively infrequent while heavy fuel oil spills contributed to the total volume of spilled oil. In general the heavy fuel oil spills were larger than other incidents. This is due to the occurrence of relatively large vessel bunkering spills. Had rail and truck incidents also been included, they would have further increased the number and volume of diesel and gasoline spills.

Figure 14 — Recent Spills 25 to 10,000 Gallons: Number of Spills by Oil Type

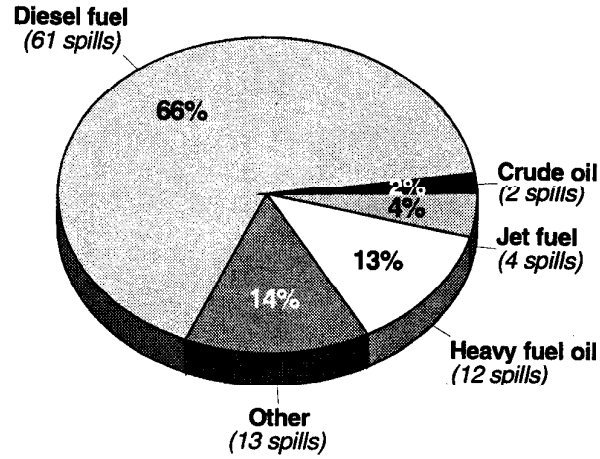
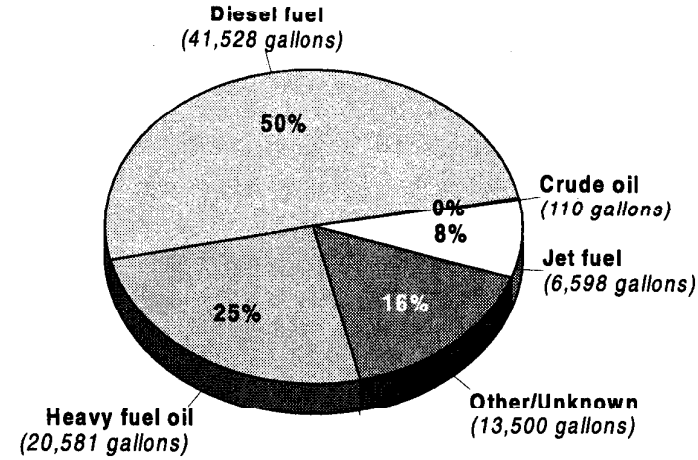


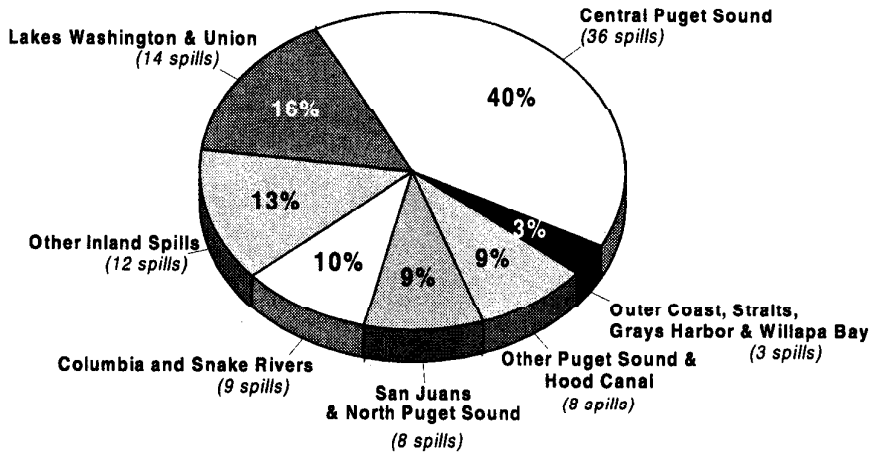
Figure 15 — Recent Spills 25 to 10,000 Gallons: Volume of Spills by Oil Type



Geographical Distribution

Figure 16 shows the distribution of spills among the Northwest Area Committee's Geographic Response Plans (GRP). More than half of the spills (50) occurred in the Central Puget Sound GRP and in Lakes Washington and Union. This area includes the state's largest population center, the Seattle/Tacoma metropolitan area. Other areas experiencing large numbers of spills included the San Juan Island/North Puget Sound area and the Columbia River.

Figure 16— Recent Spills 25 to 10,000 Gallons: Spill Distribution by GRP



Figures 17 and **18** show the distribution of spills among Ecology's regional offices. The northwest regional office (NWRO) experienced more spills than any other region. However, the amount of oil spilled in the southwest region (SWRO) was approximately equal to that of the more populated northerly region. Interestingly, over both spill size distributions discussed in this report (spills greater than 10,000 gallons discussed in **Chapter 3** and the data in this chapter), spills in SWRO were larger than NWRO. This data again probably under represents the volume and number of spills in the central and eastern regions because surface transportation incidents (rail and truck) were not included in the analysis.

Figure 17 — Recent Spills 25 to 10,000 Gallons: Number of Spills by Ecology Region

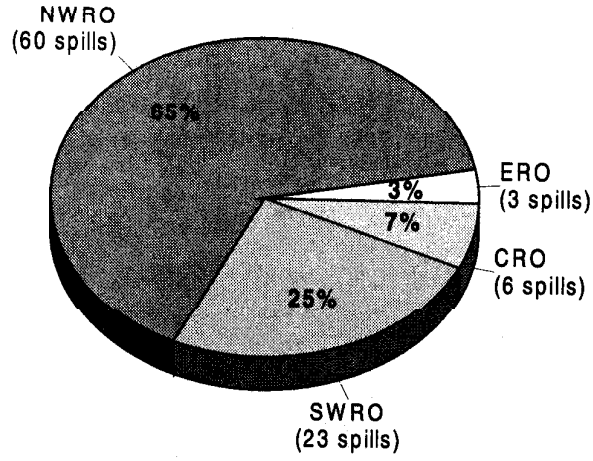
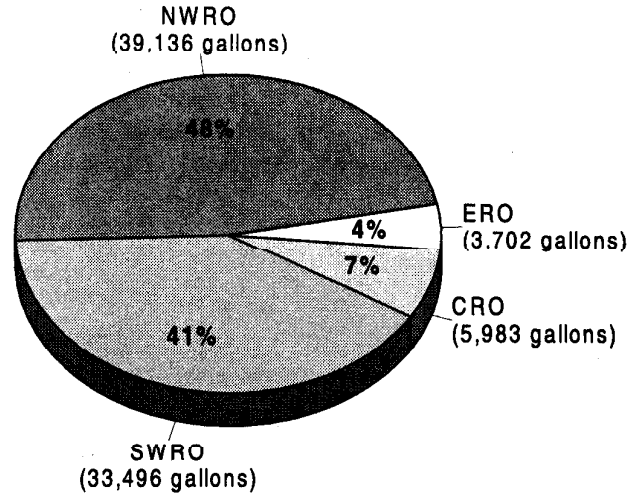


Figure 18 — Recent Spills 25 to 10,000 Gallons: Volume of Oil Spilled by Ecology Region



Figures 19 and **20** show that similar to the major spills discussed earlier in the report, recent medium-sized oil spills have had a significant impact on the marine waters compared with freshwater and land environments. However, primarily as a result of pipeline spills, land spills which represent only nine percent of the spills by number resulted in 29 percent of spills by volume.

Figure 19 — Recent Spills 25 to 10,000 Gallons: Number of Spills by Impacted Medium

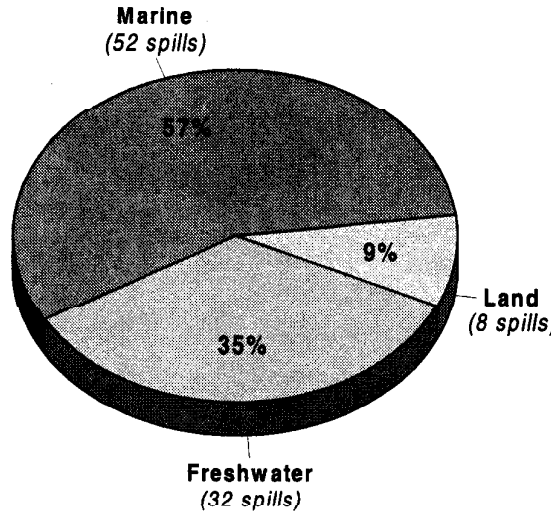
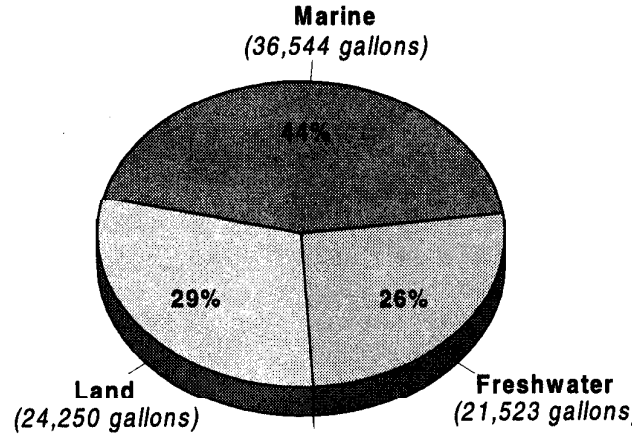


Figure 20 — Recent Spills 25 to 10,000 Gallons: Volume of Spills by Impacted Medium



Comparison with Coast Guard Data

The U.S. Coast Guard maintains a national data base which can be used to evaluate both national and regional trends in oil spills. Spill data from 1991-1995 currently under review by the Coast Guard's District XIII staff in Seattle, seems to confirm the general trends shown in **Figure 13.** This data for the Puget Sound Marine Safety office indicates that 62 percent of the volume of oil spilled came from vessels, 34 percent came from facilities and four percent from another source.

National trends identified by the Coast Guard's "Marine Environmental Protection Performance Indicators" indicates that major and medium sized oil spills may be trending downward. This potential trend appears to be consistent with **Figure 2** of this report. Ecology will continue to work closely with our federal partners to track and report on trends as they emerge.

Cause of Recent Spills

The analysis and understanding of the causes of major spills is not as simple. There are a myriad of reasons for this, including:

- **Most major spills are difficult to analyze** given that they are often the result of a series of complex factors and conditions coming together at a particular moment in time. The factors may include both failures which are preventable, and conditions which are not within human control. Often a major incident would not have occurred if any one of the factors or conditions had been absent. Therefore, it is often difficult to boil an incident down to a single primary/root cause with identified contributing factors.

- **There is a lack of a consistent framework** for systematically analyzing and categorizing incidents. This is a problem both nationally and in Washington State.

- **There is lack of consistently collected reliable information** on spill causes. This is partially due to the scarcity of highly trained staff resources in the investigating agencies, the reluctance of industry to fully disclose information for liability reasons and the lack of agency funding to hire independent experts to conduct professional investigations.

- **There is also a reluctance on the part of many investigators** to directly place blame because of liability concerns, sympathy for an individual or organization who has already been affected by an incident, and concern that an employee who may have contributed to an incident may lose their livelihood. The result is that some investigations identify the cause of an incident as equipment failure or a natural event, even when an easily preventable human error (individual or organizational) occurred.

However, there is a consensus that most major spills are caused by some form of human error and are therefore preventable. In order to provide additional insight into the types of human error, this report further distinguishes between individual human factors and management/organizational factors. The terms used in this report are defined as follows:

- **Management/Organization** — The failure of an organization to provide the necessary policies, procedures, equipment, personnel, supervision, training or time to safely design and operate a system which could potentially cause a spill. In order to prevent spills, an organization may be expected to go beyond currently accepted industry practices.

- **Human Factor** — The diminished ability (over which the organization has relatively little control) of an individual to safely complete a task. Examples include poor communication, drugs/alcohol, improper equipment use, inaccurate computation, inattention, procedural error, complacency, not following training procedures, fatigue, illness or sabotage/intentional.

- **Equipment** — A mechanical, structural or electrical failure not attributable to a human error-related design, material specification, manufacture/construction, installation, operation or maintenance deficiency. An example which would not qualify for this category as an "equipment failure" would be a failure from normal wear and tear as a result of lack of maintenance. This would be either a management/organization or human factor caused spill.

- **External** — Natural phenomenon such as earthquakes, floods, storms, tsunami, fog, ice, lightning, tidal conditions, sea state and landslides which occur with a magnitude outside of reasonably anticipated design or operating limits. An example of an external cause could be any act caused by Mother Nature.

For the reasons stated earlier, Ecology's data on spill cause is somewhat limited. Ecology is working to improve the systems for collecting, analyzing and maintaining spill cause data. Current initiatives include the development of an investigator training curriculum, hiring independent experts on major spills and the States/BC Oil Spill Task Force's project to provide a consistent methodology for collecting and sharing spill data on the entire West Coast.

Figures 21 and **22** show the distribution of spill causes for 41 recent spills in Washington (Note: incident cause was not identified in 51 of the other spills analyzed in this section). Based on the limited information available to Ecology, it appears that "human error" at the levels of the organization and individual predominate. Of the four cause definitions, organizational failure is the primary cause of recent spills in terms of both number of incidents and total volume of oil spilled. Human factors are the second most predominant cause of these spills.

The conclusion that human error is the primary cause of most spills is supported by findings by the Washington State Office of Marine Safety, the California Lands Commission, the U.S. Coast Guard, the Alaska Department of Environmental Conservation and most industry analysts. The definitions used in this report are identical with those being developed by the States/British Columbia Task Force for the purpose of consistently collecting cause data in the future on the West Coast.

Figure 21 — Recent Spills 25 to 10,000 Gallons: Number of Spills by Cause

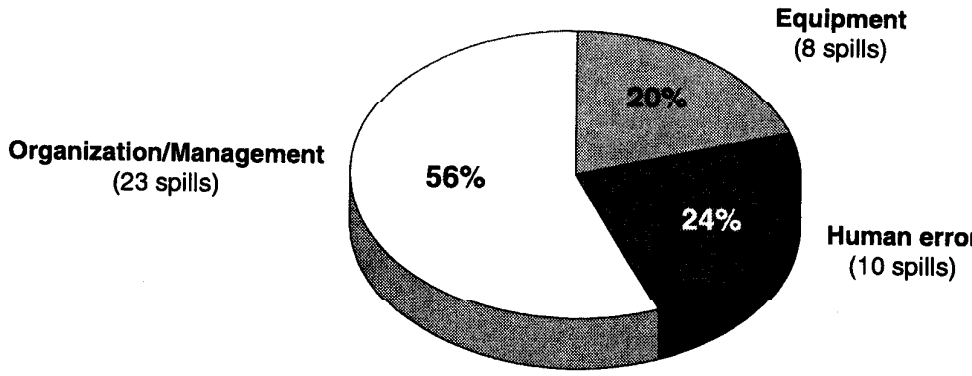
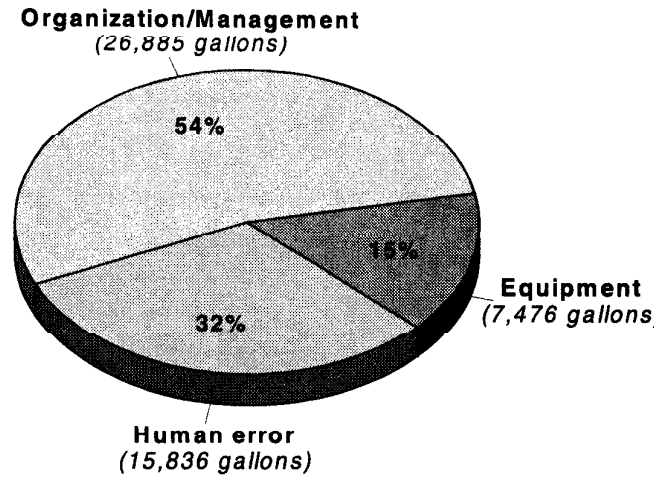


Figure 22 — Recent Spills 25 to 10,000 Gallons: Volume of Oil Spilled by Cause



Chapter 5: Near Miss Incidents

This report's **Appendix 1: Significant Vessel Casualties and Near Miss Incidents** is a list of important vessel-related incidents where there was either a major system failure or actual external damage to a vessel that occurred between 1984-96. Those incidents which did not result in the release of oil are considered to be close calls. When they are properly investigated, as much can be learned about spill prevention from these incidents as from actual spills. The state Office of Marine Safety (OMS) is currently working with other stakeholders to put a system in place which would collect information on more of these vessel incidents.

If these collisions, groundings, allisions (collision with a fixed object) and losses of power were plotted on the map outlining Washington's major oil spills **(Figure 7)**, they would largely parallel the locations where major spills have actually occurred.

Given the difficulty in agreeing on what constitutes a "near miss," the lack of incentives for reporting these incidents and the liability concerns of facility owners, it would be difficult to establish a reporting system for major non-spill incidents at marine facilities and transmission pipelines. However, Ecology will continue to follow progress by OMS and the marine industry to determine if similar discussions should be initiated with the industry segments which Ecology regulates.

Chapter 6: Lessons Learned From Recent Pipeline Spills

Over the last few years pipeline spills have occurred nationally with a frequency and environmental consequence that have raised significant concerns from the National Transportation Safety Board and others. The potential for similar major oil spills exists in Washington State. For example, two past pipeline spills involved the release of 460,000 and 168,000 gallons. These incidents show how much oil can be spilled by pipelines before the leak is detected, the system is shut down and residual drain out is controlled.

In Washington State, the major oil transportation pipelines spill only a very small portion of the products they transport. However, because of the large amount of oil which can be spilled before a spill incident is identified and controlled, they have the potential to cause serious environmental damage. Spill events during 1996 have demonstrated the need for Ecology to review current spill prevention measures for the state's major oil transportation pipelines. During 1996, the following incidents occurred:

- **On March 23, 1996, an estimated 1,560 gallons of diesel fuel** spilled from the Olympic Pipe Line into a tributary to Spencer Creek in Cowlitz County. The spill was caused by damage to the pipeline as a result of ground slumping in unstable soil in the area surrounding the pipeline.

- **On June 16, 1996, at least 1,000 gallons of gasoline and diesel fuel spilled** from a small crack in the Olympic Pipe Line into an unnamed slough near Everett. The cause of the spill may have been due to construction damage during original installation in 1972.

- **On Dec. 6, 1996, approximately 49,000 gallons of unleaded gasoline spilled** at the GATX oil storage facility on Harbor Island in Seattle. The spill resulted from a pipeline coupling failure at the plant during a product transfer from the Olympic Pipe Line. The specific cause of the spill is still under investigation and has not been determined.

It is often difficult to determine the quantity of oil lost during pipeline spills. For instance, the two Olympic Pipe Line spills went undetected for a significant period of time while oil entered soils and state waters. Ecology will continue to review the cause of these and other similar events with industry to gain a better understanding of how these spills can be prevented. This review is particularly important at this time, given the proposal for a major cross-Cascades petroleum pipeline. The state has a responsibility to assure that any new or repaired pipeline sections are constructed and operated in an optimal manner to minimize the opportunity for spills.

As a result of recent pipeline spills, Ecology is evaluating the need for industry to put in place additional protection measures. However, at this time Ecology does not have resources to institute a transmission pipeline spill prevention effort.

Conclusions

We have reached a number of conclusions after reviewing the information presented in this report. These conclusions were not based on a statistical analysis but were developed by inference after evaluating the data. The conclusions presented below are arranged by category, not priority.

Data Collection and Analysis

- **Resources needed for data collection:** Readily accessible historical data on major spills prior to the mid-1980s is incomplete. Ecology will continue to improve the collection of this information in order to better analyze the cause of significant oil spills and help the agency target its prevention efforts. This needed improvement will require Ecology to continue current efforts to improve investigator training and commit additional resources to information management. There is also a need to improve truck and rail data in particular, given the gap in this report.

Important Trends in Spills

- **Human error causes most spills:** Ecology's spill cause data indicates that most recent spills (about 80 percent) were the result of some type of human factor and were, therefore, preventable. It also appears that organization/management is responsible for significantly more incidents than the failure of an individual. These conclusions are consistent with the findings of other researchers at the national level and have important implications for spill prevention.

- **Spills occur most frequently in January:** During the last four years, the annual incidence of significant oil spills was highest during January. While we need to better understand the reasons for this seasonal influx, one factor suggests the importance of addressing the human factors component in oil spills.

- **Spills over 10,000 gallons are source of most oil:** The overall quantity of oil spilled is dominated over time by large spills greater than 10,000 gallons. The state should continue to target prevention activities for potential major spill sources. However, this report did not evaluate non-point source oil inputs to the environment, which are seldom reported to environmental agencies and can add up to large volumes. Non-point sources include leaking motor vehicle crank cases, parking lot run-off, improper disposal of used motor oil and other similar sources.

- **"Black" oil is a serious threat:** Crude and heavy fuel oils have constituted about 82 percent of the total oil released from spills over 10,000 gallons. These forms of "black" oil are among the most persistent and environmentally damaging types of oil and are very difficult to clean up. Future spill prevention efforts should continue to address vessel

spills which were responsible for about 59 percent of the total volume of oil lost from major spills and many of the incidents involving black oil.

- **Biggest risk is associated with marine transportation corridors:** The outer coast, the Strait of Juan de Fuca and the vicinity surrounding the state's major refineries are the areas at greatest risk of major spills.

- **Transmission pipelines present significant risk:** During the last four years, the volume of oil released per spill from pipeline incidents was relatively large compared with routine vessel and facility spills. With the continued occurrence of these spills, industry and Ecology should place additional emphasis on prevention of spills from major transmission pipelines.

Effectiveness of Existing Spill Prevention Measures

- **Big spill incidents may be dropping:** While it is difficult to clearly attribute the long-term trend in spills over 10,000 gallons to any specific measure, it does appear that since 1983 the number and volume of major spills in Washington has gone down (see **Figure 2**). Furthermore, this apparent decline may be occurring more rapidly than national rates. If this is true, it has good implications for the effectiveness of the state/federal and industry spill prevention partnerships which have been developed in Washington since the passage of the state's spill prevention legislation in 1991. However, the state must guard against complacency and losing focus on spill prevention.

- **Land-based spills continue to pose risk:** Washington has information on 15 petroleum oil spills of over 100,000 gallons since 1964. These major spills have included tanker and barge accidents, refinery accidents and major transmission pipeline releases. While vessel spills may present the greatest risk for catastrophic spills, refinery and transmission pipeline operations have resulted in four of the last five spills over 10,000 gallons. These facilities should continue to be the primary focus of Ecology's spill prevention efforts.

State Spill Policy

- **Effect of spills on state legislation:** As indicated in **Appendix 2**, there is a strong connection between the incidence of oil spills and subsequent legislative expansion of state responsibilities for spill prevention and response. We can expect that the future occurrence of major spills will trigger additional public expectations for improved spill prevention measures.

- **Washington has a unique energy policy setting:** Washington State has not depended solely on federal rules for the protection of its natural resources, but has established its own stringent oil spill prevention and response program. The primary factors which have influenced state policy in this area (other than actual spill events) include: the high sensitivity and value of Washington's aquatic resources; the large volume of Pacific rim trade; and the state's reliance on external crude oil resources.

- **Petroleum products exported from Washington are subject to a tax credit:** Washington State refines large volumes of petroleum products. A significant portion of the refined products are exported to Oregon and California. While our state is exposed to the spill risks associated with the importation, processing, storage and export of those products, Washington's spill prevention and response programs do not receive tax revenue from petroleum which is exported.

Appendices

Appendix 1 — Significant Vessel Casualties and Near Misses

Appendix 2 — Major Oil Spills and Related Legislative Action

Appendix 3 — Selected Spills in Washington State

Appendix 4 — Legend for Map: Spills Over 10,000 Gallons

Appendix 5 — Ecology's Regional Offices Map

Appendix 1 — Significant Vessel Casualties and Near Misses

- **August 12, 1996, Grounding** — A loaded grain ship, the *Ossolineum* grounded along the banks of the Columbia river. The vessel, which was outbound, was carrying 350,000 gallons of fuel in its tanks when it ran aground upstream from three wildlife refuges and estuaries. Luckily no oil was spilled.

- **July 11, 1996, Loss of Power** — The oil tanker *Kenai* lost power off Port Angeles. The tanker was headed toward Valdez when it stopped at Port Angeles to have its radar fixed and to refuel for the voyage. Fortunately, an escort tug was near by when the vessel lost power and was able to bring the vessel back to Port Angeles without incident.

- **July 6 1996, Shipboard Fire** — The cruise ship *Golden Princess* was headed to Vancouver, British Columbia, when a fire in the engine room caused the engines to shut down. The vessel also lost electrical power. A tug boat arrived on scene in three hours to tow the vessel to Vancouver for repairs. The vessel was carrying over 600,000 gallons of fuel when it lost power.

- **October 1994, Grounding** — The empty tanker *Keystone Canyon* broke all of her mooring lines in high winds while moored in Astoria, Oregon. The ship drifted across the Columbia River and struck the Astoria-Megler Highway Bridge. Fortunately, damage to the ship and the bridge was minimal. No oil was spilled although an empty tank was breached. A combination of weather conditions and lack of procedures lead to the grounding.

- **July 1994, Loss of power** — The 32,671 bulk carrier *Verbier* was outbound from Vancouver, British Columbia, when it lost power 2.5 miles from shore in the Strait of Juan de Fuca. After an unsuccessful attempt to be towed to port by a small tug, a second larger tug was dispatched. After several hours of towing, the tow line parted. The tug made-up again, and successfully towed the vessel to Port Angeles with the final assistance of tow other tugs. Lack of proper owner and operator oversight and support contributed to the accident.

- **July 1994, Collision** — The Chinese bulk freighter *Tian Tan Hai* collided with the fully laden tank barge *Cascades* approximately 30 miles west of the Columbia River entrance. The *Cascades* was being towed by the tug *Fairwind* and was carrying 2.4 million gallons of oil. Fortunately no oil was spilled because the collision did not rupture any cargo tanks on the barge or fuel tanks on the freighter. The barge was double-hulled. Lack of communication and adherence to regulations and policy contributed to this collision.

- **November 1993, Explosion** — The tanker *Sea River Philadelphia* suffered an explosion in her Inert Gas compartment while moored in Anacortes. Fortunately no one was injured and no oil was spilled. Inadequate maintenance procedures and possible inadequate design contributed to the explosion.

- **July 1993, Poor Vessel Condition** — The tanker *Altair* was boarded and briefly detained in Victoria, British Columbia, by the Canadian Coast Guard. The ship was in poor condition. Two months later, the *Altair* blew up and sank in the South China Sea.

- **June 1991, Grounding** — The laden tanker *ARCO Texas* ran aground at Ediz Hook in Port Angeles, Washington. No release of oil occurred.

- **September 1989, Loss of power** — The tanker *Exxon San Francisco* lost power while outbound in the Strait of Juan de Fuca. The vessel returned to Port Angeles without further problems.

- **April 1989, Loss of power** — The tanker *Exxon Philadelphia* lost power and was adrift off the mouth of the Strait of Juan de Fuca with a load of 23 million gallons of Alaska crude oil. Approximately five hours later, a tug reached the tanker and towed the ship to Port Angeles.

- **April 1988, Grounding** — The tanker Matsukaze grounded at Crescent Bay west of Port Angeles causing extensive damage to the vessel but no loss of product.

Appendix 2 — Major Oil Spills and Related Legislative Action

1964

- United Transportation Barge, Grays Harbor Co. (3/64) — 1,200,000 gallons diesel fuel

1969

- Extensive oil spill legislation was passed in 1969-1972

1971

- United Transportation Barge, Skagit Co. (4/71) — 230,000 gallons of diesel/gasoline

1972

- *General M.C. Meiggs* (U.S. Navy), Clallam Co. (1/72) — 2,300,000 gallons of fuel oil

1973

- Trans Mountain Pipeline, Whatcom Co. (1/73) — 460,000 gallons of crude oil

1983

- Olympic Pipe Line Co., Allen Pump Station (9/83) — 168,000 gallons of diesel fuel

1984

- *Tanker SS Mobil Oil*, Columbia River (3/84) — 200,000 gallons of fuel oil

1985

- Olympic Pipe Line, King Co. (11/85) — 34,000 gallons of jet fuel
- *ARCO Anchorage*, Port Angeles (12/85) — 239,000 gallons of crude oil

1986

- Concurrent Legislative Resolution 19 established an oil spill advisory committee
- Olympic Pipe Line, King Co. (5/86) — 70,000 gallons of oil

1988

- *Barge MCN#5* (Olympic Tug & Barge), Skagit Co. (1/88) — 70,000 gallons of heavy oil.
- *Nestucca Barge* (Sause Towing), Grays Harbor Co. (12/88) — 231,000 gallons of fuel oil.

1989

- HB 2242 — Established financial responsibility requirements for vessels.
- SB 6701 — Washington State Maritime Commission (WSMC) established.
- HB 1853 & 1854 — Natural Resource Damage Assessment methodology.
- *Exxon Valdez* grounding, AK (3/89) — 11,000,000 gallons of crude oil. This spill resulted in significant legislative changes in Washington, as well as other U.S. states and Canada.

1990

- HB 2494 — Broad spill preparedness & contingency planning legislation
- HB 6528 — Pilotage legislation
- OPA 90 — Passage of the Federal Oil Pollution Control Act of 1990
- Navy Supply Depot, Kitsap Co. (2/90) — 70,000 gallons of diesel fuel
- Texaco, Skagit Co. (3/90) — 130,000 gallons of diesel fuel
- Chevron Richmond Beach, King Co. (8/90) — 176,000 gallons of asphalt
- PNW Terminals, Pierce Co. (11/90) — 200,000 gallons of tallow

1991

- HB 1027 — Broad legislation with a spill prevention focus
- US Oil Tacoma, Tacoma (1/91) — 600,000 gallons of crude oil
- Texaco Refinery, Anacortes (2/91) — 210,000 gallons of crude oil
- *Tenyo Maru* (COSCO Shipping), Canadian waters at entrance to Strait of Juan de Fuca (7/91) — 100,000 gallons of diesel & heavy oil

1992

- HB 2389 — Amendments to 1991 legislation
- Chevron Pipeline, Lincoln Co. (11/92) — 20,000 gallons of jet fuel

1993

- HB 1144 — Established OMS vessel inspection program
- US Oil Refinery, Tacoma (10/93) — 264,000 gallons of crude oil
- *M/V Nosac Forest* (Barber International), Tacoma (4/93) — 6,260 gallons of fuel oil
- *M/V Central* (Azuero Shipping), Columbia River (6/93) — 3,000 gallons of fuel oil

1994

- ESHB 1107 — Marine Oversight Board Abolished
- HB 1407 — Washington State Maritime Commission privatized
- Crowley Barge 101, Rosario Strait (12/94) - 26,900 gallons diesel of fuel
- An Ping (Shanghi Hai Xing Shipping), Columbia River (1/94) - 2,771 gallons of fuel oil

1995

- ESHB 2080 — Merged OMS with Ecology, legislation was struck down by superior court action

1996

- Initiative 188 fails — Bans off-shore drilling; eliminates OMS merger; adjusts spill funding
- GATX, Harbor Island Seattle (12/96) — 49,000 gallons of unleaded gasoline

Appendix 3 — Selected Spills in Washington State

(Arranged by date)

Incident Date	Incident Name	Total Quantity Spilled (Gallons)	Product Type
03/10/1964	V-UNITED TRANSPORTATION BARGE	1,200,000	DIESEL FUEL
04/26/1971	V-UNITED TRANSPORTATION BARGE # U	230,000	DIESEL FUEL
01/01/1972	V-GENERAL M.C. MEIGGS	2,300,000	HEAVY FUEL OIL
06/04/1972	V-WORLD BOND	21,000	CRUDE OIL
01/10/1973	P-TRANS-MOUNTAIN PIPELINE	460,000	CRUDE OIL
01/01/1978	V-BARGE	100,000	DIESEL FUEL
12/31/1980	F-WHATCOM CREEK PENTA SPILL	20,000	OTHER OIL
05/01/1981	V-ST. ANTHONY	2,000	CRUDE OIL
09/23/1983	P-OLYMPIC PIPELINE	168,000	DIESEL FUEL
03/20/1984	V-SS MOBIL OIL TANKER SPILL	200,000	HEAVY FUEL OIL
11/28/1985	P-OLYMPIC PIPELINE	34,000	JET FUEL
12/20/1985	F-CHEVRON BULK STORAGE TERMINAL	1,440	HEAVY FUEL OIL
12/21/1985	V-ARCO ANCHORAGE	239,000	CRUDE OIL
01/31/1988	V-MCN#5 BARGE	70,000	HEAVY FUEL OIL
12/23/1988	V-NESTUCCA BARGE	231,000	HEAVY FUEL OIL
02/25/1990	F-MANCHESTER NAVAL SUPPLY DEPOT	70,000	DIESEL FUEL
03/27/1990	F-TEXACO REFINERY	130,000	DIESEL FUEL
07/14/1990	F-PNW TERMINALS	30,000	OIL OTHER, TALLOW
08/10/1990	F-CHEVRON RICHMOND BEACH PARK	176,000	OTHER OIL
11/17/1990	F-PNW TERMINALS TALLOW SPILL	200,000	OIL OTHER, TALLOW
01/06/1991	F-US OIL AND REFINING COMPANY	600,000	CRUDE OIL
01/15/1991	P-TRANS MOUNTAIN	3,025	OTHER OIL
02/22/1991	F-TEXACO REFINERY	210,000	CRUDE OIL
02/28/1991	V-HANJIN CONTAINER	210	DIESEL FUEL
07/22/1991	V-TENYO MARU	100,000	HEAVY FUEL OIL AND DIESEL
12/11/1991	P-TRANS MOUNTAIN PIPELINE	3,528	CRUDE OIL
03/07/1992	P-TRANS MOUNTAIN PIPELINE	2,100	CRUDE OIL
06/30/1992	V-SUN ROSE	850	HEAVY FUEL OIL
07/04/1992	T-TWIN CITY FOODS	100	DIESEL FUEL
07/17/1992	V-SAMSON TUG	70	GASOLINE
08/22/1992	F-WASHINGTON WATER POWER	370	DIESEL FUEL
10/11/1992	V-ARCTIC ALASKA	30	DIESEL FUEL
11/03/1992	P-CHEVRON PIPELINE	20,000	JET FUEL
12/15/1992	V-ARCTIC ALASKA FISHERIES	500	DIESEL FUEL
01/07/1993	V-ARCTIC ALASKA FISHERIES	800	DIESEL FUEL
03/02/1993	V-F/V ROVER	495	DIESEL/LUBE OIL
04/15/1993	V-USS CAMDEN	5,400	HEAVY FUEL OIL
04/25/1993	F-PORT OF PORT TOWNSEND	900	DIESEL FUEL
04/25/1993	V-NOSAC FOREST	6,260	HEAVY FUEL OIL
05/04/1993	V-DUTCHIE C	60	DIESEL FUEL
06/01/1993	F-PENINSULA FUEL	35	DIESEL FUEL
06/03/1993	V-M/V CENTRAL	3,000	HEAVY FUEL OIL
08/03/1993	V-GREAT PACIFIC	100	DIESEL FUEL
08/05/1993	V-F/V EXCELLENCE	2,995	DIESEL FUEL
08/05/1993	V-ARCTIC ALASKA	50	DIESEL FUEL
08/08/1993	PACIFIC N. OIL	80	HEAVY FUEL OIL
08/13/1993	V-F/V RADIO	360	LUBE OIL
09/06/1993	V-STORMY SEA	30	DIESEL FUEL
10/14/1993	V-TIDEWATER SPILL	3,295	DIESEL FUEL
10/15/1993	V-F/V ANELA	50	DIESEL FUEL
10/18/1993	F-US OIL	264,000	CRUDE OIL
11/23/1993	V-WA D.O.C.	25	DIESEL FUEL
11/25/1993	F-U.S. NAVY	560	DIESEL FUEL
12/22/1993	V-USS NIMITZ	308	JET FUEL
01/07/1994	V-ISLAND TUG	40	DIESEL FUEL
01/10/1994	V-AN PING 6	2,771	HEAVY FUEL OIL
01/26/1994	F-FOSS MARITIME	300	DIESEL FUEL
01/30/1994	V-F/V TRIAL	40	DIESEL FUEL
02/01/1994	V-USS CAMDEN	30	DIESEL FUEL
02/15/1994	V-TUG DAUB	483	DIESEL FUEL
02/15/1994	F-NORTHWEST ENVIRO SERVICES	5,500	DIESEL FUEL

Incident Date	Incident Name	Total Quantity Spilled (Gallons)	Product Type
05/10/1994	V-GOLDEN DAWN	85	DIESEL FUEL
06/06/1994	V-USS SACRAMENTO	200	DIESEL FUEL
06/14/1994	V-MATTHEW	50	GASOLINE
06/29/1994	F-L.U. DRYDOCK	1,000	DIESEL FUEL
07/18/1994	V-JOE C	700	DIESEL FUEL
08/09/1994	V-USS ARCADIA	325	DIESEL FUEL
09/11/1994	V-OMAR	200	LUBE OIL
09/22/1994	V-J. MICHELLE	100	HYDRAULIC OIL
10/15/1994	V-TYSON SEAFOOD	25	DIESEL FUEL
10/15/1994	V-BRENEVA	500	DIESEL FUEL
10/27/1994	V-USS SACREMENTO	3,700	JET FUEL
11/05/1994	V-F/V SITKOF	100	DIESEL FUEL
11/13/1994	V-NOAA	80	DIESEL FUEL
12/17/1994	V- JUPITER	50	DIESEL FUEL
12/31/1994	V-CROWLEY BARGE 101	26,900	DIESEL FUEL
01/11/1995	F-DAINTER RANCH	300	DIESEL FUEL
01/20/1995	V-POLAR CUB	200	DIESEL FUEL
01/25/1995	V-U.S. NAVY	2,520	JET FUEL
01/25/1995	F-JOHNSON CONTROL	50	HYDRAULIC OIL
01/26/1995	V-TRIPOLI	30	DIESEL FUEL
01/27/1995	F-WEYERHAEUSER, LONGVIEW BUNKER SP	1,000	HEAVY FUEL OIL
01/30/1995	V-DAPHNE	400	DIESEL FUEL
02/10/1995	V-IMCO CONST.	37	DIESEL FUEL
02/17/1995	V-NX PRESSION	250	DIESEL FUEL
02/20/1995	TACOMA SCHOOL DISTRICT	50	HEAVY FUEL OIL
02/23/1995	V-CATHERINE	200	DIESEL FUEL
02/26/1995	V-USS-NIMITZ	100	DIESEL FUEL
04/22/1995	V-MARTINIQUE	55	DIESEL FUEL
05/24/1995	V-A. KOLLONTOY	100	DIESEL FUEL
06/02/1995	V-N. VICTOR	30	DIESEL FUEL
07/16/1995	V-BETTY JEAN	25	DIESEL FUEL
07/18/1995	V-RYBAKCAUTOKY	100	DIESEL FUEL
08/09/1995	V-GASTELLO	50	HEAVY FUEL OIL
08/13/1995	F-DISTINCTIVE PROPERTIES	30	DIESEL FUEL
08/19/1995	V-PELICAN	40	GASOLINE
09/14/1995	V-DAVID R. RAY	50	DIESEL FUEL
09/14/1995	V-SEA NEST	75	DIESEL FUEL
09/29/1995	V-DIANE	50	DIESEL FUEL
10/21/1995	F-SR 509 'D' STREET POND	50	HEAVY FUEL OIL
10/31/1995	F-TOSCO	85	CRUDE OIL
11/12/1995	V-OMAR	120	DIESEL FUEL
01/04/1996	V-MUSKRAT	30	HYDRAULIC OIL
01/05/1996	V-COMMODORE	241	DIESEL FUEL
01/06/1996	F-U.S. OIL	25	CRUDE OIL
01/14/1996	F-SNOQUALMIE PASS OIL TANK	200	HOME HEATING FUEL
02/06/1996	V-TANKER NEPTUNE	378	DIESEL FUEL
02/21/1996	V-REBEL	50	DIESEL FUEL
02/28/1996	V-BERNERT BARGE	308	DIESEL FUEL
03/23/1996	P-OLYMPIC PIPELINE	1,561	DIESEL FUEL
03/25/1996	V-NORTHERN LADY	450	DIESEL FUEL
04/16/1996	V-POLAR QUEEN	37	DIESEL FUEL
04/20/1996	T-WIND RIVER TRAIN DERAILMENT	65,000	DIESEL FUEL
04/21/1996	F-ROCK ISLAND SPILL	700	OTHER OIL
04/22/1996	V-ISSWAT	35	DIESEL FUEL
05/06/1996	F-WAPATO RANCH	4,000	HOME HEATING FUEL
05/15/1996	V-EXPEDITIONS 3	100	DIESEL FUEL
06/11/1996	V-U.S. NAVY	70	JET FUEL
06/17/1996	P-OLYMPIC PIPELINE	1,500	DIESEL FUEL
12/06/1996	F-GATX HARBOR ISLAND	49,000	GASOLINE, UNLEADED

This table lists all spills analyzed in this report. Also included are additional spills which included non-petroleum products or for which agency data is incomplete.

Appendix 4 — Legend for Map: Spills Over 10,000 Gallons
(Ranked by spill size)

	Incident Date	Incident Name	Total Quantity Spilled (Gallons)	Product Type
1	01/01/1972	V-GENERAL M.C. MEIGGS	2,300,000	HEAVY FUEL OIL
2	03/10/1964	V-UNITED TRANSPORTATION BARGE*	1,200,000	DIESEL FUEL
3	01/06/1991	F-US OIL AND REFINING COMPANY	600,000	CRUDE OIL
4	01/10/1973	P-TRANS-MOUNTAIN PIPELINE	460,000	CRUDE OIL
5	10/18/1993	F-US OIL	264,000	CRUDE OIL
6	12/21/1985	V-ARCO ANCHORAGE	239,000	CRUDE OIL
7	12/23/1988	V-NESTUCCA BARGE	231,000	HEAVY FUEL OIL
8	04/26/1971	V-UNITED TRANSPORTATION BARGE # U	230,000	DIESEL FUEL
9	02/22/1991	F-TEXACO REFINERY	210,000	CRUDE OIL
10	01/17/1990	F-PNW TERMINALS TALLOW SPILL**	200,000	OIL OTHER, TALLOW
11	03/20/1984	V-SS MOBIL OIL TANKER SPILL	200,000	HEAVY FUEL OIL
12	08/10/1990	F-CHEVRON RICHMOND BEACH PARK	176,000	OTHER OIL
13	09/23/1983	P-OLYMPIC PIPELINE	168,000	DIESEL FUEL
14	03/27/1990	F-TEXACO REFINERY	130,000	DIESEL FUEL
15	07/22/1991	V-TENYO MARU	+100,000	HEAVY FUEL, OIL & DIESEL
16	01/01/1978	V-COLUMBIA RIVER BARGE***	100,000	DIESEL FUEL
17	02/25/1990	F-MANCHESTER NAVAL SUPPLY DEPOT	70,000	DIESEL FUEL
18	01/31/1988	V-MCN#5 BARGE	70,000	HEAVY FUEL OIL
19	05/06/1966	P-OLYMPIC PIPELINE	70,000	OTHER OIL
20	04/20/1996	T-WIND RIVER TRAIN DERAILMENT****	65,000	DIESEL FUEL
21	12/06/1996	F-GATX HARBOR ISLAND	49,000	GASOLINE, UNLEADED
22	11/28/1985	P-OLYMPIC PIPELINE	34,000	JET FUEL
23	07/14/1990	F-PNW TERMINALS**	30,000	OIL OTHER, TALLOW
24	12/31/1994	V-CROWLEY BARGE 101	26,900	DIESEL FUEL
25	06/04/1972	V-WORLD BOND	21,000	CRUDE OIL
26	11/03/1992	P-CHEVRON PIPELINE	20,000	JET FUEL
27	12/31/1980	F-WHATCOM CREEK PENTA SPILL	20,000	OTHER OIL
28	04/27/1980	V-WILLAPA BAY SPILL***	20,000	OTHER OIL
29	04/23/1974	P-TRANS MOUNTAIN PIPELINE	16,128	CRUDE OIL
30	06/24/1990	V-SULAK	15,000	DIESEL FUEL
31	02/07/1990	P-OLYMPIC PIPELINE	12,600	DIESEL FUEL
32	08/12/1988	F-NAS WHIDBEY ISLAND	11,000	JET FUEL
33	01/01/1991	T-MONITOR TANKER*****	10,000	GASOLINE
34	03/28/1990	F-U.S. NAVY SUPPLY CENTER	10,000	DIESEL FUEL

V = Vessel spill
P = Transmission pipeline spill
F = Facility spill

\+ The Tenyo Maru contained over 400,000 gallons when it sank, at least 100,000 gallons was released during the initial incident.

The following spills were not included in the report analysis because:

- * the spill occurred prior to 1970.
- ** this was a non-petroleum spill.
- *** there is inadequate spill information.
- **** this was a land transport spill; considerably less than 65,000 gallons was actually released.
- ***** this was a land transport spill.

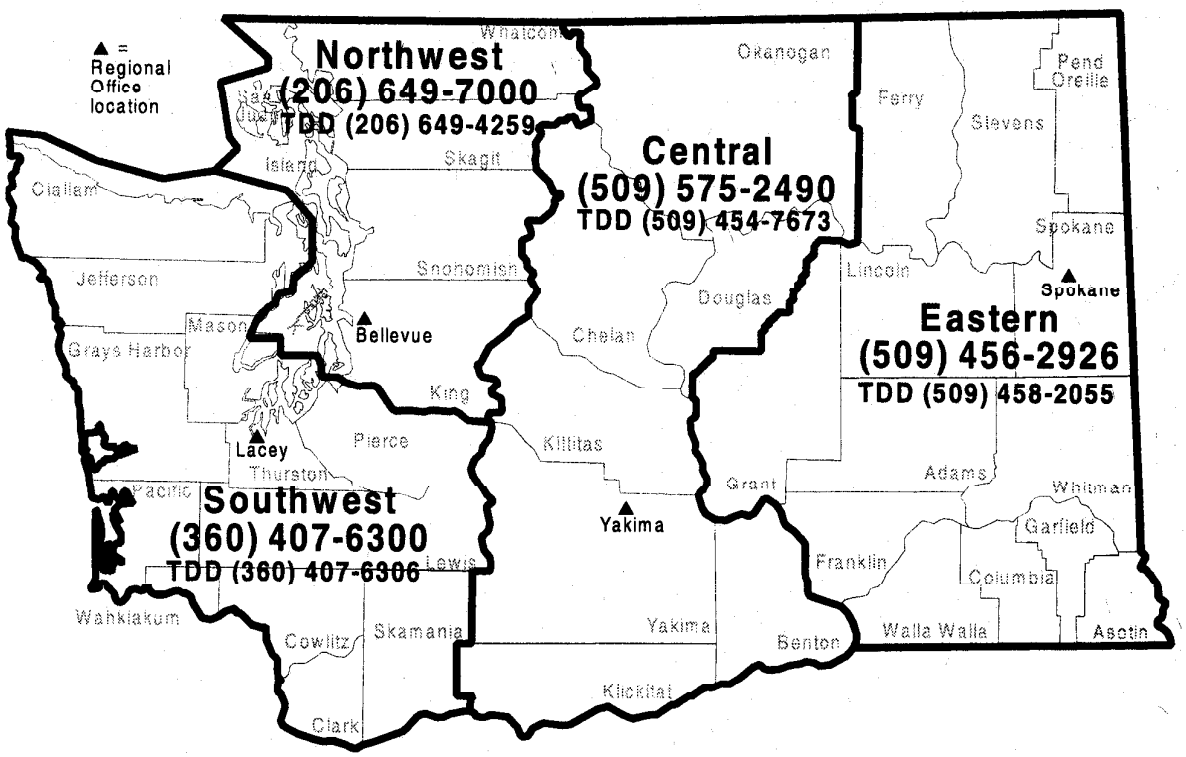
Other major spills will be added to this list as more information becomes available. Additional major spills have occurred at Kalama Chemicals, the City of Tacoma's power plant, US Oil in Tacoma, and on Whidby Island from an unknown source.

Appendix 5 — Ecology's Regional Offices

WASHINGTON STATE DEPARTMENT OF ECOLOGY

Washington Department of Ecology

Regional Office 24-Hour Oil and Hazardous Materials Spill Reporting Numbers



Need to Know:

- Reporting Party
- Contact Phone(s)
- Responsible Party
- Material Released
- Location
- Dead/Injured Fish or Wildlife
- Quantity
- Concentration
- Cleanup Status

Or call the state Emergency Management Division's 24-hour number at:

1-800-258-5990 or **1-800-OILS-911**

For EPA and U.S. Coast Guard reporting, call the National Response Center at:

1-800-424-8802

Emergency numbers for other states and federal agencies:

Idaho: Communications Center (208) 327-7422 *Oregon:* Emergency Management (503) 378-6377
EPA Region X, Seattle: (206) 553-1263 *British Columbia:* Provincial Emergency Program (800) 663-3456